MEMOIRS

OF THE

ASIATIC SOCIETY OF BENGAL

VOL. VI, pp. 1—74.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

EDITED BY N. ANNANDALE, D.Sc., F.A.S.B.

PART I.

CALCUTTA:
PRINTED AT THE BAPTIST MISSION PRESS, AND PUBLISHED BY
THE ASIATIC SOCIETY, 57, PARK STREET.
1916.

Price Rs. 4 ; or 5*s.* 4*d.*

18-12-16.

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PART I.

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INTRODUCTION.

By N. ANNANDALE, *D.Sc.*, *F.A.S.B.*

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ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

INTRODUCTION.

(With Three Maps in the Text.)

By N. ANNANDALE, *D.Sc.*, *F.A.S.B.* (*Zoological Survey of India*).

I have to thank the Council of the Asiatic Society of Bengal for undertaking the publication of the results of my recent tour in the Far East and for devoting to them a special volume. The main object of this tour was to obtain material for comparison with the fauna of Indian freshwater lakes and lagoons of brackish water. I visited three countries for the purpose (Japan, the Kiangsu Province of China and that part of Siam which lies in the Malay Peninsula) and in each investigated and collected the animals of one large lake. Supplementary collections were also obtained at other localities.

In Japan I stayed nine weeks (21st September to 26th November, 1915), spending most of my time in the immediate neighbourhood of Lake Biwa in the central part of the Main Island. In China my observations were carried out in the Tai-Hu (Great Lake) of the Kiangsu Province, in the vicinity of Shanghai in the same province and on the island of Hong Kong. To no one locality in that country was I able to devote more than a few days; at the Tai-Hu I stayed five. In the Malay Peninsula, apart from a few specimens collected on the islands of Singapore and Penang and at the mouth of the Prai River on the mainland immediately opposite the latter, my attention was directed mainly to the Talé Sap or Inland Sea of Singgora, which lies in the Siamese Province of Sunkla. I also made small collections at the mouth of the Patani River, which opens into the Gulf of Siam some distance south of the mouth of the Talé Sap, and in the caves of Jalor in the same province. At the Talé Sap I spent about a month (January and February, 1916).

I do not propose at present to give a lengthy description of the various localities; full geographical details are reserved for a series of faunistic papers, which cannot be completed until the collections have been worked out from a systematic point of view. It may be as well, however, to give now a general account of the three great lakes I visited, as the conditions of life are very different not only in each lake but also, in the case of those in Japan and Siam, in different parts of the same lake.

LAKE BIWA. (Fig. 1, p. 2).

Lake Biwa (Biwa-ko in Japanese) is a inland lake situated among the mountains of the old province of Ōmi at an altitude of about 300 ft. above sea-level. It is the largest lake in Japan, having a total length of about 36 miles and a maximum

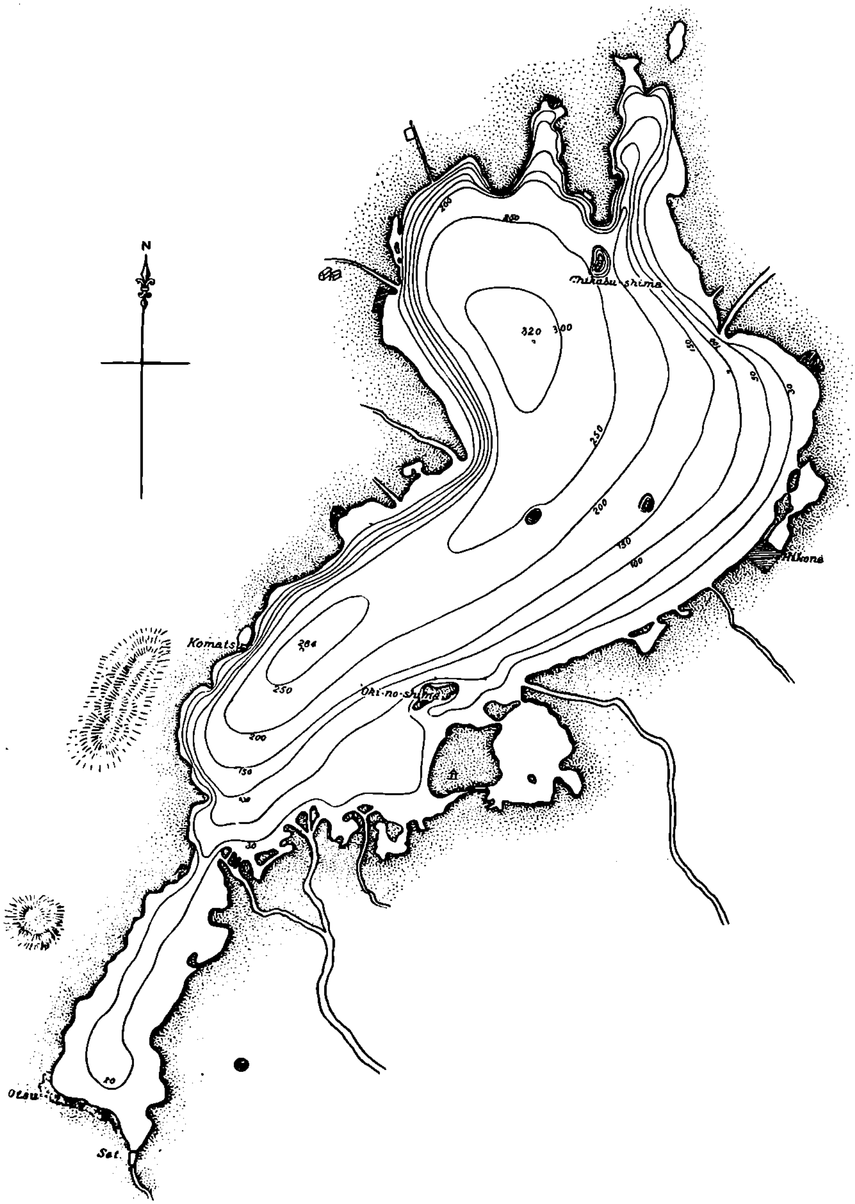

Fig. 1.—Map of Lake Biwa, showing depths in feet. Scale, *ca.* 5 miles to the inch. (After maps issued by the Meteorological and Fishery Bureaus of the Shiga Prefecture).

breadth of 12 miles. The total area is 269 square miles. The southern region of the lake is shallow and weedy, but the greater part of the northern region is over 200 feet deep and towards the north end there is a pocket of considerable size in which the depth slightly exceeds 300 feet. The water is remarkably clear and free from sediment and its temperature, considering the latitude, is high. No part of the lake ever freezes. The bottom is sandy in some places and at others muddy. There are a few small rocky islands, but the greater part of the shore is low. The river known at its exit as Seta-gawa, and at its mouth (at Ōsaka) as Yōdo-gawa, connects Lake Biwa with the Inland Sea of Japan, but there is no definite evidence that the lake ever opened directly into the sea, from which it is about 40 miles distant.

The fauna of the deeper parts of the lake, as was proved by my dredgings and will be shown in papers included in this volume, differs considerably from that of shallow water. There is also a distinct fauna associated with stony and rocky ground at the margin and round the islands.

The Tai-Hu. (Fig. 2, p. 4).

The Tai-Hu or Great Lake lies in the alluvium of the delta of the Yang-tse Kiang about 40 miles inland from the sea in a direct line. It is connected by numerous creeks and canals with the vast water-system that has been linked together for the last seven centuries by the Grand Canal of China. The lake is very shallow, the depth, so far as is known, nowhere exceeding 12 feet. The bottom is composed at most places of soft mud and the water is full of suspended silt. The length of the lake is about 60 miles and the breadth about the same. No details are known of the temperature of the water, but it is decidedly lower than that of Lake Biwa.

I was able to investigate only a small part of the Tai-Hu, but obtained indications that the fauna was remarkably uniform; the course of my short trip is indicated on the map (fig. 2) by a dotted line. The most interesting feature in the fauna, so far as can be seen at present, is the existence of a distinct marine or estuarine element, though the water is of course quite fresh.

The Talé Sap. (Fig. 3, p. 6).

The Talé Sap—a name that means in Siamese "Great Lake," just as Tai-Hu does in Chinese—differs from both Lake Biwa and the Tai-Hu in opening directly into the sea. In some respects it closely resembles the Chilka Lake on the east coast of India, but differs in that a considerable part of its water remains fresh or practically fresh throughout the year. It is divided into two distinct regions connected only by narrow channels. In the northern or inner part of the system conditions are almost normally lacustrine, while the outer or southern part is subject to great variations in salinity, but probably, except in heavy floods, contains at all seasons water that is distinctly brackish.

The whole lake-system is about 50 miles long. The water is shallow, the depth probably not exceeding 16 feet at any point in the inner lake. In the channel north

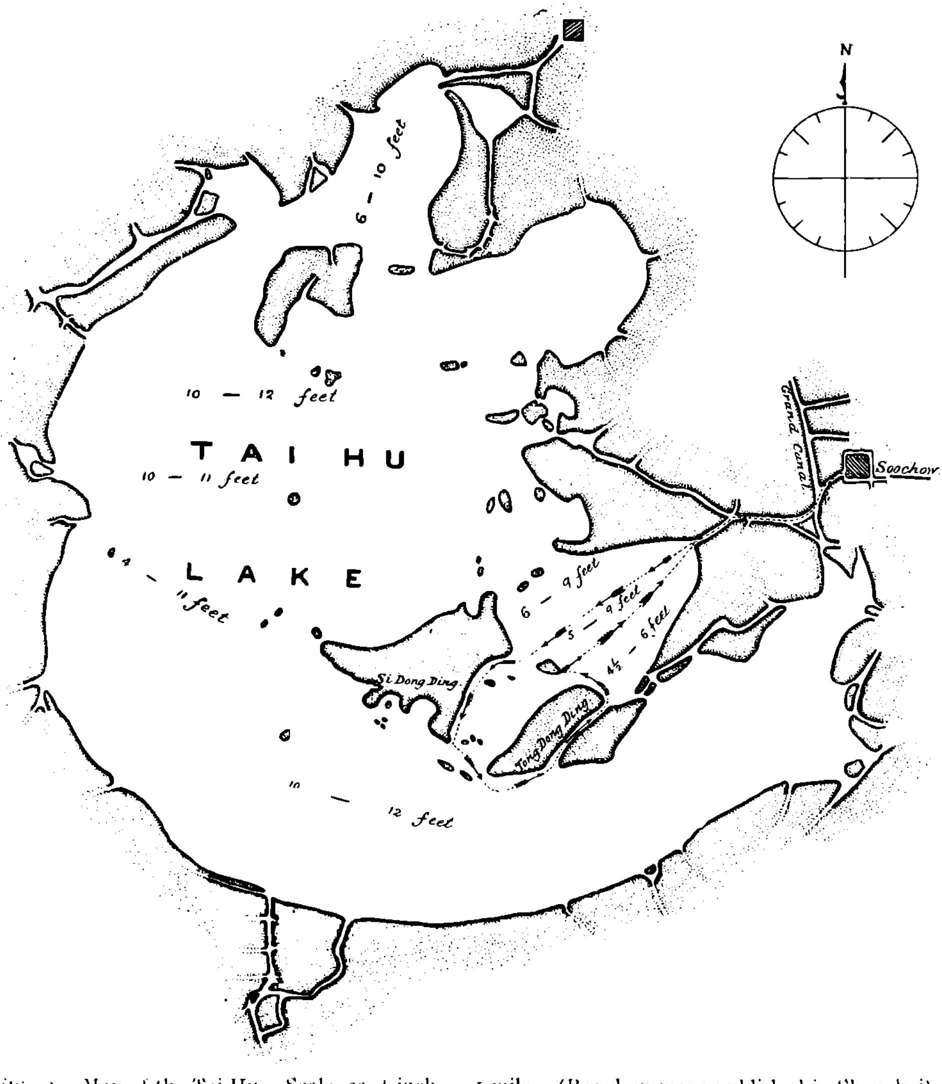

FIG. 2.—Map of the Tai-Hu. Scale, *ca.* ⅓ inch = 1 mile. (Based on maps published in Shanghai).

of the town of Singgora, just inside the mouth, there is an anchorage of 4 fathoms, but its area is very limited and the greater part of the mouth is more or less blocked by a sand-bar. Throughout the system the bottom is more or less muddy and the water is full of suspended silt. The climate is of course tropical. My visit took place at the end of the rainy and at the beginning of the dry season.

The fauna of the inner lake, as might be expected, differs considerably from that of the outer parts of the system. It is somewhat scanty, at any rate as far as the invertebrates are concerned, and includes some distinctly marine types. That of the outer lake is mainly estuarine and includes very few characteristic freshwater forms. It appears to be greatly impoverished, probably owing to frequent and sudden changes in physical conditions; but possibly more species would be found in a living condition at the beginning than at the end of the rainy season.

A short diary of my tour is given at the end of this introduction. It may be useful in settling any question that may arise as to the dates and *provenance* of specimens.

In all the countries I visited I was greatly indebted to local naturalists and officials. In Japan, Prof. H. Ishikawa, of the Medical School of the Imperial University of Kyoto, was kind enough to place at my disposal all the resources of the Ōtsu Lake Laboratory (Ōtsu Rinko Zikkensho[1]), of which he is Director, while Dr. T. Kawamura of the same school, the naturalist in charge of the laboratory, met me on my landing at Kobé and offered to act as my assistant during my stay in the country. He also accompanied me to China. I cannot express how much I owe to his assistance both scientific and personal.

At Tokyo I gained much from intercourse with biologists attached to the Imperial University and other institutions, in particular with Prof. I. Ijima, Prof. Y. Kogani, and above all with Prof. A. Oka, who accompanied me, together with Mr. Icho of the local Fishery Department, on a most interesting day's trip on the lake Kasumi-ga-Ura on the Pacific coast.

At Kyoto, in the fine Museum of Conchology founded by Mr. Y. Hirasé, I received much help from him and from his assistant Mr. J. T. Kuroda in the identifications of Mollusca and in references to literature on that group.

At Shanghai Dr. A. Stanley, Municipal Health Officer and Honorary Curator of the Museum of the North China Branch of the Royal Asiatic Society, helped me in ways too numerous to be specified.

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[1] The history of this laboratory is as follows: The idea of the erection of a laboratory of the kind was first mooted by Prof. H. Ishikawa and Dr. T. Kawamura of the Physiological School in the Medical Institute of the University at Kyoto. They approached the Prefect of the Shiga Prefecture and the Corporation of the city of Otsu. The former was unable at the time to make a grant from prefectural funds, but the Corporation presented a site, a small peninsula in the lake that had been formed from the materials dug out in the excavation of a tunnel connected with power stations at Kyoto. This site had been placed at the disposal of the Corporation by the company concerned in the excavations. The Corporation further undertook to erect a building 54 square fathoms in area, with out-buildings of 25 square fathoms, at a total cost of about 3,000 yen (= Rs. 4,500). The Imperial University of Kyoto agreed to make a yearly grant of 1,600 yen (= Rs. 2,400); Prof. Ishikawa was appointed director and Dr. Kawamura biologist in charge. A second biologist was appointed temporarily and a scientific assistant and a laboratory attendant permanently. The laboratory was handed over to the University on September 25th, 1914.

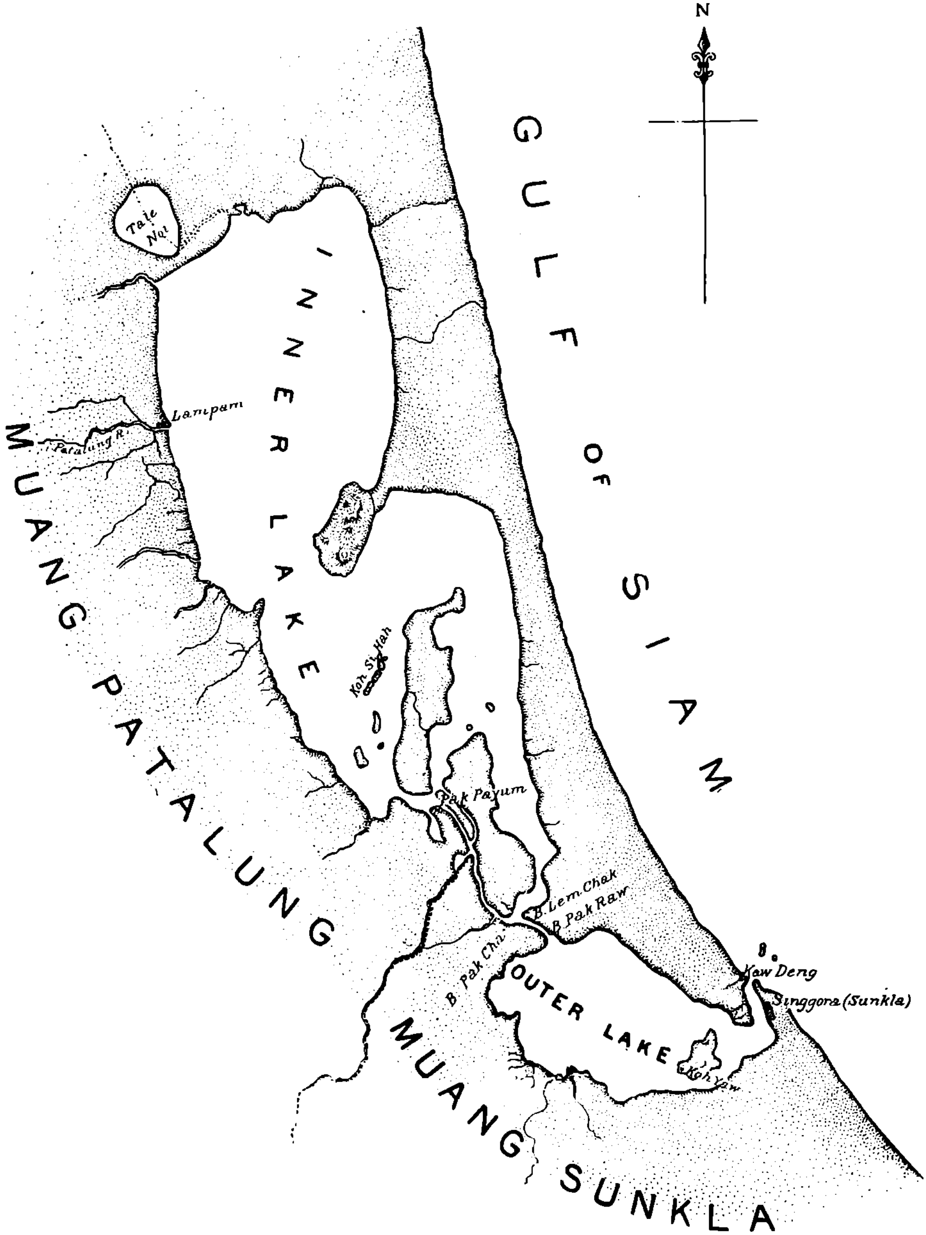

FIG. 3.—Map of the Talé Sap. Scale, $\frac{3}{16}$ inch = 1 mile. (After map published by Royal Siamese Survey Department in 1907).

Mr. H. C. Robinson, Director of Museums, Federated Malay States, not only provided me with alcohol and other preservatives, but placed at my disposal the services of two Dyak collectors, whose work was most useful; he also accompanied me as far as Penang and arranged that the Government of the Federated Malay States should lend me the Fisheries Steamer 'Shark,' which took me to Trang on the west coast of Peninsular Siam. I must also thank Dr. R. Hanitsch of the Raffles Museum, Singapore, Mr. I. H. Burkill, Director of the Botanical Gardens, Singapore, and Mr. C. Boden Kloss, Assistant Director of Museums, Federated Malay States, for help in various directions.

The Siamese Officials at Patalung and at Singgora gave me much assistance, while Mr. W. Dunn, His Britannic Majesty's Consul at Singgora, was kind enough to make arrangements for the hire of a motor-boat on the Talé Sap. Mr. J. Caunter, assistant in the Indian Museum, accompanied me to this lake and helped greatly in the work of collecting.

Lastly I must express my obligations to specialists in India and abroad who have undertaken the description of various parts of the collections made.

Diary of a Tour in the Far East.

August, 1915—*February*, 1916.

August 27th-30th .. In Rangoon.

September 2nd .. Reached Penang on the "Ceylon Maru."

September 3rd .. Started from Penang by train for Singapore at 8 A.M. and reached Kuala Lumpur in the Federated Malay States at 5-30 P.M. Mr. H. C. Robinson, Director of Museums in the Federated Malay States, met me at the station and took me up to his house, where I met Mr. C. Boden Kloss, the Deputy Director. We discussed my tour in the Siamese States and arranged for co-operation in collecting, etc. Left again for Singapore in the evening.

September 4th .. Reached Singapore at about half past eight in the morning. Called at the Raffles Museum and met Dr. R. Hanitsch, the Director. He took me round the galleries, showed me what was new since I was there fourteen years ago and explained to me the work he had recently undertaken on the Malayan Blattidae. In the afternoon called on Mr. I. H. Burkill, Director of the Botanical Gardens, who was formerly Superintendent, Indian Museum, Economic and Art Section, and discussed with him my trip to the Siamese States.

September 5th .. Spent the afternoon in the Botanical Gardens and collected the peculiar eggs and larvae of the toad *Kaloula pulchra*. Obtained some interesting notes thereon.

September 6th .. Rejoined the "Ceylon Maru" and sailed for Hong Kong.

September 12th	..	Landed at Hong Kong and went collecting in the little hill-streams, where I got a number of interesting Crustacea and frog larvae.
September 13th	..	Sailed for Shanghai.
September 16th	..	Reached Shanghai at night.
September 17th	..	Visited the Shanghai Museum, which belongs to the North China Branch of the Royal Asiatic Society, and called on Dr. A. Stanley, the Honorary Curator. He received me most hospitably and took me out in his motor to collect specimens in the neighbourhood of the town.
September 18th	..	Sailed for Japan.
September 21st	..	Reached Kobe in the morning and was met by Dr. T. Kawamura, Lecturer on Physiology in the University of Kyoto and Naturalist in charge of the Otsu Lake Laboratory, who placed his services at my disposal as assistant during my stay in Japan. We discussed plans and left for Kyoto the same afternoon.
September 22nd-24th.		Stayed in Kyoto making preparations for my work at Otsu and investigating the Hirase Conchological Museum.
September 25th	..	Started work at Lake Biwa with Kawamura.
September 26th-29th.		Studied the topography of the lake and the littoral fauna in the neighbourhood of Otsu.
September 30th	..	Started on a four days' tour of the lake on a small steamer that I had hired.
October 3rd	..	Reached Otsu again with large collections dredged from the deeper parts of the lake.
October 4th-8th	..	Worked in the Otsu Laboratory on the collection of sponges and sorted out specimens already collected.
October 9th	..	Spent the day in Kyoto at the Hirase Museum and was much helped in the identification of shells by Mr. Hirase, the Director.
October 10th	..	Left for Tokyo, which I reached the same evening.
October 11th	..	Spent the day making acquaintance of the zoologists in the University and at the 3rd Higher School and discussed anthropological matters with Prof. Kogani at the Anatomical Institute.
October 12th-13th	..	Visited various scientific institutions in Tokyo and looked up literature in the University Library.
October 14th	..	Visited the Marine Biological Institute at Misaki with Dr. Fugita of the Zoological Institute.
October 15th	..	Spent the day at Kasumi-ga-Ura, a lake near Tokyo, with Dr. A. Oka and two officers of the local Fishery Department.

October 17th ..	Visited the Imperial Museum at Tokyo.
October 18th ..	Went to Yokohama.
October 19th ..	Returned to Otsu and commenced work in the laboratory.
October 20th-25th ..	Worked in the laboratory and collected specimens in the neighbourhood.
October 26th-28th ..	Worked at Komatsu on the western shore of the lake and made large collections.
October 29th-November 1st ..	Worked in the laboratory.
November 2nd ..	Spent the day in Kyoto at the Hirase Museum and in the laboratories of geology and geography at the University.
November 3rd-5th ..	Worked in the laboratory at Otsu and collected specimens in the neighbourhood.
November 6th ..	Spent the day at the Fishery Station of the Shiga Prefecture at Hikone on the eastern shore of the lake.
November 8th-11th ..	Worked in the laboratory at Otsu.
November 12th ..	Visited various gold-fish amateurs and inspected the Shimadzu factory of scientific apparatus.
November 13th ..	Helped at the annual exhibition at the Otsu Laboratory and packed specimens.
November 14-16th ..	Packing collections and working out sponges.
November 17th-22nd.	Stayed in Kyoto. Collected Crustacea from fishmongers' shops.
November 23rd ..	Went with Dr. Kawamura to Osaka and met Dr. Yoshida, Zoologist to the Medical Institute of that city. In the afternoon went to Kobe by electric tram to arrange for despatch of collections, etc., to India.
November 24th ..	Spent the day on the Yodo River in a launch lent by the head of the Municipal Sanitary Department; dredged and collected specimens on the banks of the river.
November 25th ..	Went back to Kobe and made final arrangements for despatch of collections.
November 26th ..	Sailed from Kobe for Shanghai, accompanied by Dr. T. Kawamura.
November 29th ..	Reached Shanghai and made arrangements for a trip by house-boat to the Tai-Hu (Great Lake), about 40 miles inland.
November 30th ..	Started for Tai-Hu in a house-boat towed with many others by a launch.
December 1st ..	Reached the city of Soochow and had to wait for a long time while the Custom House officers examined the various boats. In the afternoon got off again and went down the Moo-Too creek.
December 2nd-6th ..	Worked on the Tai-Hu.
December 7th ..	Returned to Soochow; bought fish in the market and specimens of shell-windows commonly used there.

December 8th ..	Got back to Shanghai and started packing.
December 9th ..	Continued packing and worked at sponges collected in the Tai-Hu. In the afternoon Dr. A. Stanley took us to see the Museum of the Jesuits' College at Zikkawei, some miles out of Shanghai.
December 10th ..	Went out dredging in the Whangpo River in a launch borrowed by Dr. Stanley.
December 11th ..	Finished packing collections and working out sponges.
December 12th ..	Sailed for Hong Kong on the SS. "Kamo Maru."
December 15th ..	Reached Hong Kong and found a letter from Sir Charles Eliot, Vice-Chancellor of the University, asking me to stay in his house. In the afternoon went collecting in the small streams on the Peak.
December 16th ..	Sailed for Singapore.
December 21st ..	Arrived at Singapore. Arranged with Dr. R. Hanitsch to go out on the shore to look for certain sponges of which specimens were wanted for the Indian Museum.
December 22nd ..	Examined the collection of Pedunculate Cirripedes in the Raffles Museum and went out shore-collecting with Dr. R. Hanitsch and his assistants.
December 23rd-30th	Stayed at the Botanical Gardens, Singapore, and collected there daily; also investigated the life-history of the toad *Kaloula pulchra*.
December 31st ..	Left Singapore by boat for Port Swettenham *en route* for Kaula Lumpur.
January 1st ..	Reached Port Swettenham and was met by Mr. H. C. Robinson. Went up by train to Kuala Lumpur and spent the afternoon in the Selangor Museum.
January 2nd ..	Went to Batu caves and collected samples of the fauna.
January 3rd ..	Visited the Federated Malay States Medical Institute and examined the collection of parasitic insects.
January 4th ..	Left Kuala Lumpur in the morning, accompanied by Mr. Robinson, and reached Taiping in the afternoon. Went through the Perak Museum with Mr. Robinson and Mr. Evans, the Curator.
January 5th ..	Went through collecting apparatus sent on from India and made final preparations for Siamese trip.
January 6th ..	Sailed from Port Weld near Taiping with Mr. H. C. Robinson on the F.M.S. Fisheries steamer "Shark," which the Federated Malay States Government had kindly placed at my disposal. Collected sponges at Port Weld while waiting for the rise of the tide and dredged off Penang Island. Reached Georgetown, Penang, in the evening.

January 7th-8th ..	Stayed in Penang while the boat was coaling and a pilot was being found.
January 9th ..	Sailed for Trang in the Siamese Malay States on the "Shark" with Mr. L. C. Boden Kloss, Mr. H. C. Robinson having been obliged to return to Kuala Lumpur.
January 10th ..	Arrived at Trang and made arrangements to book luggage to Patalung on the Talé Sap, the railway being broken down beyond this point.
January 11th ..	Started in the morning and reached Patalung at night after much difficulty at the Patalung Road station, which turned out to be some miles from the town.
January 12th-16th ..	Collected in the Talé Sap near Patalung and in the Patalung river but was unable to obtain suitable boats.
January 17th ..	Started very early in the morning on a house-boat for Singgora and reached the Koh Si Hah (Five Islands) fairly early. Spent the day collecting on the islands and round the shore.
January 18th ..	Left the islands and reached a place called Pak Raw, collecting some specimens on the way.
January 19th ..	Reached Singgora in the afternoon and arranged through the British Consul for the hire of a motor-boat.
January 20th-23rd ..	Collected on the shore of the Talé Sap near Singgora.
January 24th-30th ..	Went out daily in the motor-boat dredging and tow-netting in the lake.
January 31st-February 1st ..	Collected near Singgora and commenced packing specimens.
February 2nd ..	Sailed for Patani some distance down the coast, leaving Mr. J. Caunter, my assistant, to finish packing the specimens
February 3rd ..	Called on the High Commissioner of the Province of Patani, who took me round the States of Patani and Nawnchik in his motor. Arranged to hire a car to take me to the Jalor caves next day.
February 4th ..	Went to Biserat by motor and spent the day in the neighbouring caves.
February 5th ..	Collected at the mouth of the Patani river and in the bay outside. Left Patani in the evening.
February 6th ..	Reached Singgora and finished all business there.
February 7th ..	Started by motor at 5-30 a.m. for Alor Stah in the British Protected State of Kedah, which we reached about 12 noon. Left for Penang by train the same afternoon.
February 8th-12th ..	Stayed in Penang, collecting daily in the Botanical Gardens or elsewhere. Sailed for Madras.

N. ANNANDALE.

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ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

POLYZOA ENTOPROCTA AND CTENOSTOMATA.

By N. Annandale, *D.Sc.*, *F.A.S.B.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

POLYZOA ENTOPROCTA AND CTENOSTOMATA.

(Plate I; plate II, figs. 1, 1*a*.)

By N. ANNANDALE, *D.Sc.*, *F.A.S.B.* (*Zoological Survey of India*).

The Polyzoa discussed or described in this paper are all from fresh or brackish water. The majority are from the Talé Sap in the north-eastern part of the Malay Peninsula, but a few come from the Tai-Hu in the Kiangsu Province of China. I have also included notes on one Indian form. The following species are to be considered :—

ENTOPROCTA.

Chitaspis athleticus, gen. et sp. nov., from the Talé Sap.

CTENOSTOMATA.

Alcyonidium mytili, Dalyell, from Indian estuaries, etc.
Triticella pedicellata (Alder), from the Talé Sap.
Bowerbankia caudata, Hincks, from the Talé Sap and Perak.
Paludicella elongata, Leidy, from the Tai-Hu.
Paludicella pentagonalis, sp. nov., from the Talé Sap.
Victorella bengalensis, Annandale, from the Talé Sap.
Hislopia cambodgiensis (Jullien), from the Tai-Hu.
Hislopia malayensis sp. nov., from Jalor in the Malay Peninsula.

It will be as well to defer consideration of the biology and distribution of these species until I have been able to deal systematically with the Phylactolaemata and Cheilostomata collected on my tour. All that need be said here is that while the species of *Paludicella* and *Hislopia* are from fresh water, the others on the list are from brackish water.

ENTOPROCTA.

The only species of Entoproctous Polyzoon represented in my collection was found in brackish water in the Talé Sap on the Gulf of Siam. It represents an undescribed species and genus of the family Urnatellidae.

I take this opportunity to state that my identification[1] of a species of *Barentsia* from the Mutlah R. in the Gangetic delta as *B. discreta* (Busk) was incorrect. The

[1] Annandale, *Rec. Ind. Mus.* VII, p. 205 (1912).

specimens represent *B. gracilis*[1] (Sars), as is apparent from Harmer's detailed description and figures.

Family URNATELLIDAE.

1915. Annandale, *Mem. Ind. Mus.* V, p. 127.

In the paper cited I discussed the limits of this family, which I restricted provisionally to the genera *Urnatella*, Leidy and *Loxosomatoides*, Annandale The discovery of a new genus that is evidently allied closely to the latter but yet has certain affinities with *Myosoma*, Robertson, makes it at any rate probable that *Myosoma* should also be included. The following key shows the more striking differences between these genera :—

I. Stalk segmented, each segment heavily chitinized and capable of functioning as a resting bud .. .. *Urnatella.*

II. Stalk not segmented.

- A. Aboral surface of both stalk and capitulum bearing scattered chitinous spines; no chitinous shield on capitulum. Muscles of stalk entering capitulum .. .. .. *Myosoma.*
- B. A chitinous shield, sometimes spiniferous, on aboral surface of capitulum only.
  1. Muscles of stalk nearly straight, completely surrounding it, not entering capitulum .. .. .. *Loxosomatoides.*
  2. Muscles of stalk directed downwards and outwards from the capitulum, confined to oral and lateral surfaces of the stalk, meeting in the lower part of the capitulum with well-defined oblique capitular muscle-bands at an angle .. *Chitaspis* (nov.)

With the exception of *Myosoma*,[2] the species of these genera have been found only in fresh or brackish water. *Urnatella* is fluviatile and is only known from the neighbourhood of Philadelphia, U.S.A. Two species of *Loxosomatoides*[3] occur in lagoons and deltaic tracts on the east coast of India, while the new genus *Chitaspis* is represented by a species from a lagoon connected with the Gulf of Siam. *Myosoma* was described from a species found in the sea on the Pacific Coast of North America.

Chitaspis, gen. nov.

This genus consists of Urnatellidae with unsegmented stalks and capitular shields like those of *Loxosomatoides*. The muscles of the stalk, however, emerge from the capitulum; they are directed outwards and downwards and are confined

[1] See Harmer, *Siboga-Exp.*, mon. XXVIIIa, p. 27 (1915).

[2] Robertson, *Proc. California Acad. Sci.* (Zool.) II (3), p. 324 (1900).

[3] Annandale, *Rec. Ind. Mus.* II, p. 14 (1908) and *Mem. Ind. Mus.* V, p. 128 (1915).

to the oral and lateral surfaces of the stalk; within the capitulum they meet at an angle with a pair of well-defined oblique muscular bands on each side.

TYPE-SPECIES.—*Chitaspis athleticus*, sp. nov., from the Talé Sap, Gulf of Siam.

Closely allied as is the type-species to *Loxosomatoides*, the arrangement of its musculature is so conspicuously different that a new genus is necessary for its reception. In this point it is different from all other Entoprocta as yet known. In *Myosoma* the muscles of the stalk emerge from the capitulum in much the same way, but the oblique body-muscles are much less highly differentiated.[1] In the resting buds of *Urnatella*[2] and *Loxosomatoides*[3] oblique strands of muscles occur, but no such structures have been detected in the normal capitulum. The body-muscles described by Ehlers[4] in *Barentsia* (*Ascopodaria*) are by no means highly specialized and the stalk-muscles do not enter the capitulum. The Loxosomatidae are so different in other respects that no confusion is possible and discussion as to resemblances and differences in the musculature is unnecessary here.

Chitaspis athleticus, sp. nov.

(Pl. I, fig. 1.)

Colony. In the type-specimens the colony consists of a segmented, entirely adherent stolon that branches sparingly on the surface of a stone and gives rise at considerable intervals to single upright polyps. Polypiferous and non-polypiferous segments alternate with some regularity, the latter being by far the longer of the two. The lateral branches are given off, as a rule singly, from polypiferous segments of the stolon. The stolon is flattened below and evenly arched above; it varies somewhat in diameter, but does not exceed 0·082 mm. Both stolon and polyps are covered with a rather thick chitinous investment which varies somewhat in thickness, but is not more than 0·0041 mm. thick; on the aboral surface of the polyps this ectocyst is modified to form the aboral shield characteristic of the genus and of *Loxosomatoides*.

Polyp. Each polyp consists of a short stalk bearing a relatively large capitulum. The stalk is rarely if ever longer than, and as a rule rather shorter than, the capitulum. It is relatively very stout and does not taper much above; there is no defined swelling at its base. The capitulum is rather broadly oval as seen from in front or behind; it is not much compressed. Large capitula are about 0·374 mm. high and 0·272 mm. broad. The diameter of the stalk may be as much as 0·17 mm. at the base.

The normal number of tentacles is 18.

The aboral shield varies considerably in extent but never encroaches on the oral surface. When fully developed it covers the whole of the aboral surface, and has well-defined limits. It never bears spines but is ornamented with a minute network of fine ridges that encloses polygonal depressions of somewhat variable size and outline but never more than 0·051 mm. in greatest diameter. The ridges are slightly

[1] Robertson, *Proc. California Acad. Sci.* (Zool.) II (3), p. 324, pl. xvi, figs. 1-12 (1900).

[2] Davenport, *Bull. Mus. Comp. Zool. Harvard* XXIV, p. 24, pl. vi, fig. 57 (1893).

[3] Annandale, *Mem. Ind. Mus.* V, p. 130, fig. 2 (1915).

[4] Ehlers, *Abh. Kong. Gesells. Wiss. Göttingen* (Math.-Naturw. Kl.) XXXVI, p. 64, pl. iii, figs. 40, 43 (1890).

elevated at the nodes of the reticulation. The whole structure is very thin; in opaque specimens it has a pale golden colour, which contrasts well with the translucent white of the soft parts, though a yellowish tinge is given to the whole organism by the ectocyst. In specimens mounted in Canada balsam it is difficult to see details of the structure of the shield because of its transparency.

The oral surface of the capitulum and the whole surface of the stalk is quite smooth.

The general anatomy, both in the stalk and in the capitulum, closely resembles that of *Loxosomatoides*, except in respect to the musculature. Some polyps in my specimens possess unripe gonads in the form of a broad transverse band interrupted before and behind and lying in the upper half of the capitulum.

Musculature. The spincter of the orifice consists of a considerable number (at least 6) of circular strands. The strands that lie externally are more or less inter-

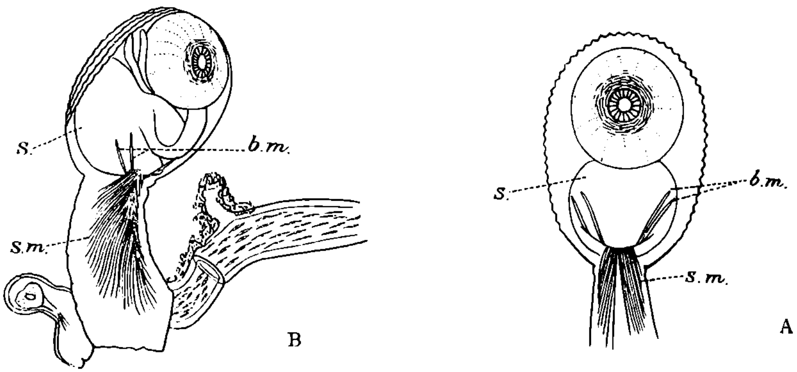

FIG. 1.—*Chitaspis athleticus*, gen. et sp. nov., × 62.

A. Oral view of a polypide. B. Oblique lateral view of another polypide with a bud and part of the stolon.

b.m. = capitular muscles. *s.* = stomach. *s.m.* = stalk muscles.

rupted. The muscles of the lophophore apparently resemble those of *Loxosomatoides* and there is a well-marked retractor running along the centre of each tentacle.

The body-muscles lie mainly in the body-wall. Possibly the outer strand (see fig. 1) is entirely superficial, but the inner strand certainly bends inwards above and its upper end is probably attached to the outer wall of the stomach.

The muscles of the stalk are directed outwards and downwards from the capitulum on the oral surface. They usually form two somewhat divergent groups arranged symmetrically, but this is more clearly the case in some polyps than in others. The lower end of the muscle is situated distinctly above the base of the stalk. I have not been able to detect any trace of muscle-fibres on the aboral face of the stalk or in the rhizome.

Type-specimen. No. 7157/7 Z.E.V., Ind. Mus. (Zool. Survey of India): in alcohol.

Locality, etc. The island of Koh Yaw, outer part of the Talé Sap (Great Lake) on the Gulf of Siam; at the edge of the lake in water of very variable salinity but having a specific gravity (corrected to a standard temperature of 15°C) of 1·00625 at the time when the specimens were taken. The type-specimen was attached to a stone that had been built into a sea-wall. It was accompanied by colonies of *Bowerbankia caudata* and of the Cheilostomes *Membranipora hippopus* and *M. bengalensis.*

ECTOPROCTA.

Order **Gymnolaemata**.

Suborder **Ctenostomata**.

Harmer's recent account of the Ctenostomata of the 'Siboga' Expedition[1] has done much to elucidate the internal relationships of this very difficult group, and although I have not been able to accept all his conclusions on the families of fresh and brackish water (which naturally do not come fully into view in the consideration of the results of a naval expedition) I must here express my indebtedness to this admirable work, which has done for the seas of the Malay Archipelago almost as much as Hincks' *British Marine Polyzoa* did for those of Great Britain. In saying this I do not of course mean to infer that the Polyzoa of that vast area in the East are as well known as those of British seas were even in Hincks' time; but there is now a solid foundation on which further study can be based.

The suborder is well represented among the Polyzoa of fresh and brackish water in eastern lakes and ponds, but until recently our knowledge of the anatomy of critical genera has been very scanty, mainly owing to the fact that a number of the more important forms, though easily preserved in formalin or alcohol, collapse and become valueless if transferred to oil of cloves or cedar. It is thus very difficult to examine stained specimens under a high power of the microscope, without the aid of which I find it impossible to ascertain details with certainty. Harmer (*op. cit.*, p. 41) gives elaborate directions, based on the methods put forward by Rousselet, for the mounting of specimens in formalin for microscopic examination, but specimens so prepared, though often both beautiful and useful, cannot be satisfactorily used under really powerful objectives. Moreover, the methods are so elaborate, tedious and costly that it is difficult to mount a sufficiently large number of preparations in the case of variable forms. I find it necessary, in the case of species like those of *Victorella* and *Bowerbankia*, to examine not several but many preparations and to search in all for details that cannot be seen unless the organisms are stained and rendered transparent, and also, if not flattened, at any rate rendered as flat as may be possible without distortion. For this purpose a simple modification of Rousselet and Harmer's technique is sufficient, though I cannot say it it is permanent; the preparations will last, in a tropical climate, at least for two or even three years, and possibly for longer.

I place the specimens to be mounted, after staining with borax carmine and cleaning in acid alcohol, in a 50% solution of glycerine in 70% alcohol and leave

[1] *Siboga-Expeditie.* Monograph XXVIIIa. *The Polyzoa of the Siboga Expedition.* Pt. I. *Entoprocta, Ctenostomata and Cyclostomata* (Leiden, 1915).

them exposed in a shallow dish for 24 hours. They are then transferred to a drop of pure glycerine on a slide, and, if there is any danger of crushing, fragments of a broken cover-slip are arranged round the drop. A complete cover-slip of relatively large size is cleaned and a square or circle of rather thick Canada balsam solution painted round it to the requisite thickness. It is then dropped from a pair of forceps over the glycerine on the slide, the painted side of course being downwards. The glycerine and the balsam are pressed together without mixing.

It is always as well at the same time to attempt to mount some specimens in Canada balsam after clearing them in the ordinary way. Ninety per cent or more of such attempts will, in the case of the more delicate tubular species, result in failure; but the few zooecia that do not collapse will prove particularly valuable. I am of course presuming that abundant material is available, and this is usually the case if the investigator be also the collector.

In the species of *Hislopia* and *Paludicella* (*i.e.* in the most abundant of the true freshwater Ctenostomata) there is as a rule no difficulty in clearing preparations with oil of cloves, the ectocyst being relatively thick and at the same time more permeable to oils.

To understand the Ctenostomata and their classification it is necessary above all things to study the general anatomy of the polypide and in particular of that part of the alimentary canal that lies between the mouth and the stomach. Some confusion exists in the terminology of this system, more particularly in reference to the terms "oesophagus" and "gizzard." The former has been applied in two entirely different senses, while the latter has been used indifferently in a morphological and in a physiological sense.

It is in the Division Alcyonellea or Carnosa that the simplest and probably the most primitive condition is to be found.

In *Alcyonidium* the mouth opens into a comparatively short funnel-shaped "oesophagus." The walls of this organ are very thick above and become gradually thinner towards its base, which is defined by a circular valve, the so-called "cardia" or, as I prefer to call it, the oesophageal valve. When this valve is open the lumen of the oesophagus is practically continuous with that of the stomach, at any rate when the polypide is expanded. The region that intervenes between the valve and the stomach proper or "pylorus" takes the form of a rather stout tube, the walls of which do not differ in essential histological characters from those of the latter. There are apparently no circular muscles in the wall of this region, which may be known as the cardiac region.

In the Stolonifera the structure of this part of the alimentary canal seems to be essentially the same as in the Alcyonellea, but in the Paludicellea a progressive differentiation is found in the different families. In the Paludicellidae (fig. 2, A) the only marked changes that occur are that the oesophagus is greatly lengthened and more or less distinctly differentiated into an external thick-walled funnel shaped "pharynx" and a thin-walled oesophagus proper, and that scattered circular muscle-fibres appear in the wall of the cardiac region.

In the Victorellidae (fig. 2, B) this region is much more highly specialized and consists of three parts. Immediately below the valve there is a comparatively large oval chamber without muscle-fibres, but lined internally with a fine layer of horny substance. Below this there is a short muscular tube, the external wall of which is composed of close-set circular fibres, and finally a relatively long thick-walled glandular tube connects the muscular region with the pylorus.

In the Hislopiidae (fig. 2, C) still further specialization occurs. Three parts can again be distinguished, but their arrangement and structure are very different from

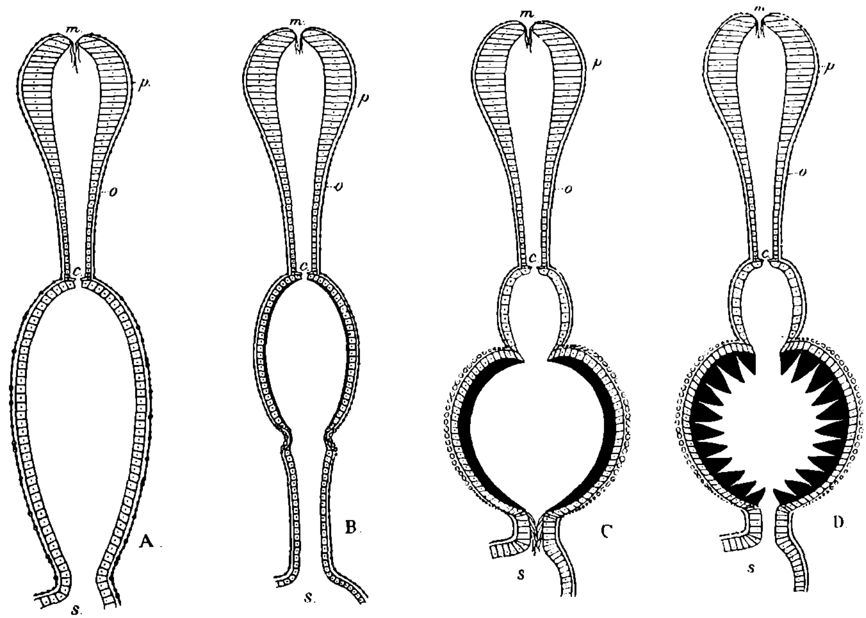

FIG. 2.—Diagram of the oesophageal and cardiac regions of the alimentary canal in certain families of Ctenostomata.

A.—Paludicellidae. B.—Victorellidae. C.—Hislopiidae. D.—Vesiculariidae.

c. = oesophageal valve. *m.* = mouth. *o.* = oesophagus proper. *p.* = pharynx. *s.* = stomach.
Cilia are represented by depending sinuous lines, circular muscles by minute circles with a dot in the centre of each, and horny structures in solid black.

the corresponding parts in *Victorella*. The outermost part, immediately below the valve, is a conical thick-walled but non-muscular "proventriculus." This opens directly into a spherical chamber of large size in which the outer wall is composed of very stout circular muscle-fibres, while the lining consists of a thick layer of horny substance that has in longitudinal section the appearance of a sharp ridge. The inner surface of this horny lining is perfectly smooth. In preserved specimens the spherical chamber has the appearance of opening directly into the pylorus, but if the living animal be examined in an expanded condition, it will be seen that a narrow ring intervenes, bearing very long and powerful cilia. It is this ring that I regard as a third part of the cardiac region. In the Vesicularina, or at any rate in *Bowerbankia* (fig. 2, D), the general structure resembles that found in *Hislopia*, except that the horny lining of the spherical chamber is broken up into a number of sharp teeth[1], and that there are no cilia on the narrow ring that separates the spherical chamber from the pylorus.

Thus, in three families, belonging to two different divisions of the suborder, we find a chamber lined with chitin in the cardiac region of the alimentary canal. In the Hislopiidae and the Vesiculariidae this chamber occupies the same position and is probably homologous, though, as we shall see in a moment, it is not analogous. In the Victorellidae it differs both in position and in function and seems to be homologous rather with the proventriculus of the other families than with their spherical chamber. If this be so, the spherical chamber of these forms is homologous with the narrow muscular part in *Victorella*. In *Bowerbankia* the function of the chamber with the horny teeth is that of a true gizzard. It crushes the food. In *Hislopia* the function is rather that of a store-chamber; the chitinous lining has very little crushing power and its function is merely to maintain the spherical form of the chamber in a position of rest, without preventing a change of shape and consequent diminution of the lumen in muscular contraction.[2] In *Victorella* the function of the horny region seems to that of retaining hard particles of irregular shape which might injure the delicate walls of the stomach, the natural food consisting of diatoms with a smooth surface.[3]

In this summary description I have taken the oesophageal valve as a fixed point, as seems to be justified by a comparative study of the alimentary canal in different groups of Ctenostomata; but the term oesophagus has been applied in *Alcyonidium* by others not only to that region to which I have confined it, but also to the whole of the alimentary canal between the mouth and the stomach proper. The term "gizzard" is applicable, in a physiological sense, only to forms like *Bowerbankia* and *Cryptozoon*, and it is perhaps best not to use it either for the homologous, but not analogous, structure in *Bowerbankia*, or for the superficially similar, but neither homologous nor analogous, structure in *Victorella*.

Division *ALCYONELLEA*.

Harmer[4] in his recent report on the Ctenostomata of the 'Siboga' has revived Gray's name Carnosa (1841) for this division, on the ground that Ehrenberg's name Halcyonellea (1839) included Phylactolaemata as well as Ctenostomata.

Family ALCYONIDIIDAE.

Genus **Alcyonidium**, Lamx.

1915. *Alcyonidium*, Harmer, *op. cit.*, p. 36.

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[1] In the anomalous genus *Cryptozoon*, Dendy, which perhaps belongs to this division, the horny layer takes the form of a pair of stout quadrangular masses. See Dendy, *Proc. Roy. Soc. Victoria* (n.s.), I, pp. 1-12, pls. i-iii (1889).

[2] Annandale, *Faun. Brit. Ind., Freshw. Sponges*, etc., pp. 200-202 (1911).

[3] *Id.*, *ibid.*, p. 197.

[4] *Siboga-Exp.*, mon. XXVIIIa, p. 35 (1915).

Alcyonidium mytili, Dalyell.

(Pl. I, fig. 2.)

1848. *Alcyonidium mytili*, Dalyell, *Rare and Remark. Anim. Scotland* II, p. 36, pl. xi, figs. 1-4.
1906. *Alcyonidium mytili*, Silberman, *Arch. f. Naturg.*, Jahr. 72, I, p. 265. pls. xix. xx.
1915. *Alcyonidium mytili*, Annandale, *Mem. Ind. Mus.* V, p. 127.
1915. *Alcyonidium polyoum*, Harmer, *op. cit.*, p. 37, pl. iii, fig. 1.

Harmer says, on the synonymy of this species: "It is probable that *Sarcochitum polyoum*, Hassall, 1841, is the form assumed by old colonies of *A. mytili*." But mere probability (which in this case is by no means strengthened by an examination of Indian specimens) is a poor excuse for discarding well-known specific names in favour of others much less well known.

I did not take *A mytili* on my recent tour, but as I have fairly abundant material from India it will be well to give in this paper a description of Oriental specimens from brackish water.

My specimens are on the shells of Gastropod molluscs (*Purpura* or *Thais carinifera* and *Potamides fluviatilis*) from the Chilka Lake and on the skin of a sea-snake (*Enhydrina valakadien*) from the estuary of the R Hughli. In both cases the colony is extremely thin and transparent and when living was barely visible to the naked eye. In our survey of the Chilka Lake we saw no thickened examples, though we found the extremely inconspicuous films of the typical *A. mytili* not uncommonly. On shells the outlines of the colonies are obscured by the irregularity of the surface of attachment, but on the sea snake, to which a large number of colonies were attached, they were almost exactly circular. None were more than 2 cm. in diameter. It is probable, however, that these latter colonies were young. The zooecia and polypides agree with Harmer's figure, except that, at any rate in the central part of the colony, the zooecia are much more variable in size and shape, some being very much smaller than others. I figure a single polypide (pl. i, fig. 2) for comparison with that of other species discussed in this paper.

In living specimens from the Chilka Lake I found the number of tentacles to be 12 or 14, but in polypides dissected out from a colony from the Gangetic delta it is certainly 16, as Silberman found to be the case in European specimens.

Division *STOLONIFERA*.

Family TRITICELLIDAE.

Genus **Triticella**, Dalyell.

1915. *Triticella*, Harmer, *op. cit.*, p. 90.

Harmer may be consulted for other references. Several, if not all, of the species are probably cosmopolitan, but only two records from Indo-Pacific seas have hitherto been published, *viz.* Harmer's (*loc. cit.*) of *T. boeckii*, Sars from Algoa Bay and my own of *T. korenii*, Sars from Japan (*Rec. Ind. Mus.* VII, p. 124).

Triticella pedicellata (Alder).

(Pl. I, fig. 3.)

1857. *Farella pedicellata*, Alder, *Quart. Journ. Micr. Sci.* V, p. 24, pl. xiv, figs. 1-3.
1880. *Triticella pedicellata*, Hincks, *Brit. Mar. Polyzoa*, p. 547, pl. lxxx, figs. 1-3.
1893. *Triticella pedicellata*, Duerden, *Proc. Roy. Irish Acad.* (3) III, p. 133, pl. v, figs. 3, 5.

I found my colonies of this species on the tail of a sea-snake (*Enhydris hardwickii*) and on the carapace of *Limulus moluccanus*, taken in both cases in fishing-nets off Singgora near the mouth of the Talé Sap in January, 1916. The water had at the time a specific gravity (corrected) of 1·0085. In both cases the colonies accompanied and partly grew over those of the Cheilostome *Membranipora hippopus*.

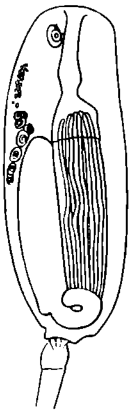

FIG. 3.—*Triticella pedicellata*, × 90.

My specimens agree closely in most respects with Duerden's description and figures of Irish examples. The rhizome (pl. i, fig. 3) is in an intermediate condition, forming neither a simple branching structure nor a flat plate but having a modified cruciform arrangement. Pairs of opposed lateral branches are given off at irregular intervals and at the meeting place of the four arms thus formed small polygonal flattened plates are budded off from the lateral branches and the main stem in the same plane. It is from these plates that the upright stalks of the zooecia arise. This formation is not mentioned by Duerden, but is shown in his plate (fig. 5). The only point in which I find any actual discrepancy is in the form of the base of the zooecium and in the manner of its attachment to the stalk (see text-figure 3), but the stalk is so delicate that it is liable to be distorted; in many of my specimens it has much the same appearance as in Duerden's fig. 3. My figure was drawn from a particularly well-preserved zooecium.

So far as I am aware, *T. pedicellata* has not hitherto been recorded from tropical waters, but only from the North Sea and the west of Ireland, where it occurs on shells in moderately deep water. As it was found in the Talé Sap attached to marine animals possessing considerable power of progression, we may suppose that it is not a permanent inhabitant of the lake, but enters brackish water occasionally.

Division *VESICULARINA*.

Family VESICULARIIDAE.

Genus **Bowerbankia**, Farre.

Bowerbankia caudata, Hincks.

(Pl. I, figs. 10, 11).

1880. *Bowerbankia caudata* and *B. gracillima*, Hincks, *Brit. Mar. Polyzoa*, pp. 521, 525, pl. lxxv, figs. 6-8.
1908. *Bowerbankia caudata* race *bengalensis*, Annandale, *Rec. Ind. Mus.* II, p. 13.

1911. *Bowerbankia caudata* subsp. *bengalensis*, *id.*, *Faun. Brit. Ind.*, *Freshw. Sponges*, etc., p. 189.

1915. *Bowerbankia caudata*, *id.*, *Mem. Ind. Mus.* V, p. 126.

I have already discussed this form so often that it may seem superfluous to return to it again, but it is clear from Harmer's remarks in his report on the 'Siboga' Polyzoa that a detailed description is still called for on my part. Harmer refers to my figure of the zooecium, but I never published one.

In the form I call *Bowerbankia caudata* the colony consists of zooecia arising singly, in pairs or in groups on both sides of a reptant rhizome that branches more or less freely both in a cruciform and in a dichotomous manner. The rhizome may occasionally be free for a considerable part of its length, but is usually adherent and

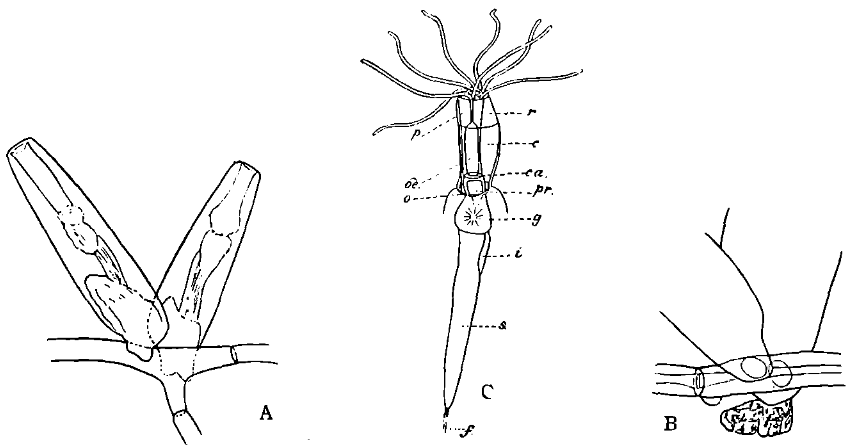

FIG. 4.—*Bowerbankia caudata.*

A.—Two polypides with apparently bifid bases, × 45. B.—Lower part of two other polypides in one of which the base has become attached to a fragment of stone, × 45. C.—Fully expanded polypide, × 45.

c. = collar. *ca.* = oesophageal valve. *f.* = funiculus. *g.* = gizzard. *i.* = intestine. *o.* = orifice of zooecium. *oe.* = oesophagus. *p.* = pharynx. *pr.* = proventriculus. *r.* = rectum. *s.* = stomach.

never gives rise to upright branches. The zooecia are invariably attached to the side of the rhizome, with the interior of which they communicate by means of a circular or oval aperture of relatively large size in their own wall and in that of the rhizome. Vertical partitions, each perforated by a single pore, occur at intervals in the rhizome. In the younger parts of the colony the normal arrangement seems to be that two zooecia arise approximately opposite one another; a partition occurs in the rhizome close to the pair of zooecia in the direction nearest to the centre of the colony, and another at some distance away, near another pair of zooecia, in the opposite direction; but this arrangement is liable to all kinds of irregularities and practically disappears in congested parts of the colony, where, for considerable distances, the zooecia are closely packed together on one or both sides of the rhizome and partitions are absent or scattered irregularly. There is never any trace of a spiral arrangement of the zooecia.

Lateral branches are usually given off in the neighbourhood of groups of zooecia, but the tips of these branches divide dichotomously in front of the last zooecium (pl. i, fig. 10).

The size of individual zooecia varies greatly both in the same colony and in colonies from different localities or growing under different conditions. If the organism is threatened by the deposition of mud in its interstices, as often happens if it is attached to the roots of reeds in muddy estuarine waters, some zooecia are often of very great length without attaining more than normal girth. The following table gives, in millemetres, the length and greatest transverse diameter in the longest zooecium discoverable in four colonies from different localities, the first two of which are situated on different sides of the Malay Peninsula, while the two latter are in the Gangetic delta:—

	Port Weld.	*Talé Sap.*	*Calcutta.*	*Port Canning.*
Length	1·78	1·02	2·55	0·775
Breadth	0·204	0·119	0·255	0·119

The zooecia are always more or less spindle-shaped, tapering both above and at the base, which is usually prolonged below the point of attachment to the rhizome in the form of a pointed process or "tail." If this tail comes in contact with a hard object it is often expanded into a funnel-like body, concave at the tip, which attaches itself to the object. Its position is sometimes a little eccentric so that it is situated at one side of rather than in the middle line of the main body of the zooecium, the base of which then grows out into a lateral pocket, thus giving the whole structure a bifid appearance (text-fig. 4, A); but the tail never forms a branching radicle. The distal region of the zooecium is subcircular in cross-section. Its ectocyst is faintly and minutely striated transversely, but the striae are often obsolete. The tint of the ectocyst varies greatly; often it is colourless but sometimes it is stained with yellow or brown. It is always transparent.

In both arrangement and number the parietal muscles vary considerably. Sometimes they are practically confined to the upper part of the zooecia, while in some zooecia they extend almost to the base (*cf.* figs. 10 and 10*a*, pl. i).

There are always 8 tentacles, which are armed with a sensory bristle at the base, with several horizontal hairs on the outer margin and a bunch of finer hairs at the tip. The alimentary canal resembles that of other species. The diameter of the gizzard varies with the size of the zooecium (*cf.* pl. i, figs. 10, 10*a* and 11).

B. caudata, therefore, differs from the form described by Waters[1] and by Harmer[2] as *B. imbricata* in the following characters:—

(1) The zooecia are more slender and less cylindrical; their base never forms a binding radicle.

(2) They are joined to the rhizome by a distinctly lateral communication and never exhibit any approach to a spiral arrangement.

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[1] *Journ. Lin. Soc.* XXXI. p. 248, pl. xxv, figs 6-10 (1910).
[2] *Siboga-Exp.*, mon. XXVIIIa, p. 70, pl. vii, figs. 15, 16 (1915).

(3) The rhizome, although it is not always adherent, never gives rise to vertical branches.

(4) The number of tentacles is always eight.

I find these characters constant in a large series of specimens from Bengal, Madras, Perak and the Talé Sap.

In eastern waters *B. caudata* is characteristic of estuarine tracts in which the water has a lower salinity than that of the open sea. I found the species abundant at Koh Yaw in water of a specific gravity (corrected) of from 1·004 to 1·0085. It occurred (often with *Victorella bengalensis*) on sticks and stones. I also took a specimen on a worm-eaten fragment of a wooden pier at Port Weld on the coast of Perak. This place is situated up a creek, some distance from the open sea (Straits of Malacca), but the water is probably almost if not quite as salt as that of the Straits.

Division *PALUDICELLEA*.

1911. Palludicellina, Annandale, *Faun. Brit. Ind.*, *Freshw. Sponges*, etc., p. 186.
1915. Paludicellea, Harmer, *Siboga-Exp.*, mon. XXVIII*a*, p. 43.

Harmer (*loc. cit.*) includes in this division the following families: Paludicellidae, Victorellidae, Arachnidiidae and Nolellidae (= Cylindroeciidae, *auct.*); whereas I have hitherto included only the Paludicellidae, Victorellidae and Hislopiidae—the last a freshwater family referred to by Harmer only in a foot-note. He supports his views as to the inclusion of certain marine genera with abundant evidence and clears up several anatomical points hitherto obscure, in particular by means of his excellent figures. These show that there is practically no difference in the general structure of the polypide between *Cylindroecium* and *Victorella*. In fig. 19 of his plate iv, for example, it is quite clear that the polypide of *Cylindroecium* (or *Nolella*) *papuensis* possesses a cardiac store-chamber and a well-defined single funiculus. Indeed, now that this evidence on anatomy is available, the grounds on which the family Cylindroecidae is separated from the family Victorellidae become rather flimsy.

It is somewhat otherwise with the Arachnidiidae, in which Harmer follows Loppens[1] in placing the freshwater genus *Arachnoidea*, Moore. His figure of the polypide of *Arachnidium irregulare* (*op. cit.*, pl. iii, fig. 6) shows quite clearly that there is neither a proventriculus, nor a spherical chamber, nor a funiculus. This, of course, does not rule *Arachnidium* out of the division—the alimentary canal is merely in a simple and probably primitive condition; but it does prove that *Arachnoidea* is by no means closely related to *Arachnidium*. *Arachnoidea* I would still retain in the family Hislopiidae on anatomical grounds, for although its anatomy is still imperfectly known, it certainly possesses a spherical chamber closely resembling that of *Hislopia*. This structure is not clearly indicated either in Moore's original sketch[2] or in Rousselet's more elaborate figure,[3] but I have seen it without a doubt in specimens mounted by the latter author and in *Hislopia* the horny lining of the gizzard remains

[1] *Ann. Biol. lacust.* III, p. 150 (1908).
[2] *The Tanganyika Problem*, p. 296, fig. (1903).
[3] *Proc. Zool. Soc. London* 1907 I), pl. xiv, figs. 5, 6.

as a fairly conspicuous object even in very badly preserved specimens. There is some reason, therefore, to doubt whether Harmer's marine species *Arachnoidea protecta* (*op. cit.*, p. 50, pl. iii, figs. 7-11) is really co-generic, notwithstanding the very close external resemblances, with *A. ray-lankesteri* from Lake Tanganyika.

I would, therefore, arrange the families of the Division Paludicellea as follows, basing their classification on the structure of the polypide as well as the form of the zooecium:—

I. Alimentary canal of simple structure, cardiac limb of stomach undifferentiated.
   A. Zooecia broad, flattened, adherent, with the orifice situated on a tubercle or short upright tubule; no funiculus.. .. .. ARACHNIDIIDAE.
   B. Zooecia relatively narrow, either entirely vertical or bearing a comparatively long, vertical orificial tubule; two funiculi .. .. PALUDICELLIDAE.

II. Alimentary canal more highly specialized in the cardiac region.
   A. Cardiac region of the alimentary canal with an antechamber (always ?) lined with chitin; no proventriculus; adult zooecia vertical and tubular; a single funiculus.
      1. Base of zooecia swollen or slipper-shaped VICTORELLIDAE.
      2. Base of zooecium sharply constricted off from the false rhizomes by which it is connected with other zooecia .. CYLINDROECIIDAE.
   B. Cardiac region of alimentary canal with a proventriculus and a spherical chamber lined with thick chitin; no funiculus.
      Zooecia flattened and adherent, with or without a high orificial tubule .. HISLOPIIDAE.

Family PALUDICELLIDAE.

Genus **Paludicella**, Gervais.

1887. *Paludicella*, Kraepelin, *Deutsch. Süsswasserbryozoen* I, p. 96.
1913. *Paludicella*, Harmer, *Proc. Zool. Soc. London* III, p. 441.
1914. *Paludicella*, Braem, *Arch. f. Hydrobiol.* IX, p. 456.

Recent authors have recognized a single species in this genus, namely *Paludicella articulata* (Ehrenberg) = *P. ehrenbergii*, v. Beneden. I have here, however, to revive a second usually relegated to the synonomy of that species and to describe a third—the latter a very distinct form. A fourth species, or what I believe to be a fourth species, occurs in Japan and will shortly be described by Prof. A. Oka.

The genus is probably cosmopolitan but has not yet been found in India, unless we accept Carter's somewhat inconclusive record.[1] Personally I am of the opinion that this record refers to a species of *Victorella*.

Paludicella elongata, Leidy.

(Pl. I, fig. 4.)

1852. *Paludicella elongata*, Leidy, *Proc. Acad. Nat. Sci. Philadelphia* V, p. 321, pl. —, figs. 1, 2.

Specimens in my collection from China agree precisely with Leidy's figures, which, however, show only the outlines of zooecia. The species differs from *P. articulata* in the following characters:—

1. The ectocyst is colourless and very thin, liable to collapse in spirit.
2. The proximal part of the zooecia is much elongated and attenuated, while the distal part, as viewed in profile, is not much deeper than the proximal; the orificial tubule is relatively short.
3. Young buds reach the full length of an adult zooecium and assume a somewhat clavate form before the orifice is developed.
4. The whole of the alimentary canal is stouter than in the common European form, the stomach in particular being much larger; when fully developed, the phyloric part has a broadly elliptical form.

The last of these differences I consider the most important. It becomes very clear if fig. 4 on pl. i be compared with the figures already published by Allman,[2] Kraepelin,[3] Hancock[4] or myself.[5] In young polypides the stomach is more slender than in those that are fully adult and the main or pyloric portion is slightly contracted in the middle and somewhat pointed at the free extremity, but even in such polypides the organ is relatively more bulky than in European specimens.

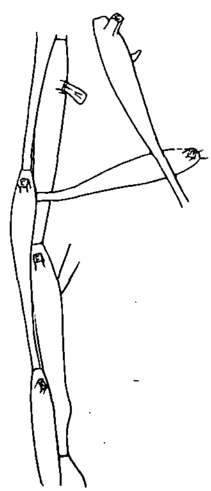


Fig. 5.—*Paludicella elongata*. Part of a colony. × 16.

The only examples of *P. elongata* I have seen were growing, with the Hydroid *Cordylophora lacustris*, on the roots of a willow, on shells of *Modiola lacustris* attached to them in large numbers, and on living shells of a Unionid mollusc (*Anodonta woodiana*). In these specimens there is no trace of vertical branches, but in the colonies on roots many of the zooecia are free and floated loosely in the water In December none of the zooecia contained mature gonads, though immature testis and ovary were found in one. They occupied the same position as in *P. articulata*. A single free resting-bud was observed. It was flattened and polygonal and had a thinner shell than is usual in *P. articulata*.

[1] *Ann. Mag. Nat. Hist.* III (3), p. 333 (1859).
[2] *Mon. Fresh-Water Polyzoa*, pl. x (1856).
[3] *Deutsch. Süsswasserbryozoen* I, pl. iii, fig. 104 (1887).
[4] *Ann. Nat. Hist.* V (2), pl. iv (1850).
[5] *Rec. Ind. Mus.* VI, pl. xii, fig. 1 (1911).

Localities.—The species was originally described, with *Urnatella gracilis*, from the Delaware and Schuylkill rivers near Philadelphia, U.S.A. My specimens were taken in a few feet of water at the mouth of the Moo-Too creek and in the north-west corner of the Tai-Hu (Great Lake) in the Kiangsu Province of China: December, 1915.

Paludicella pentagonalis, sp. nov.

(Pl. I, fig. 5.)

The type-specimen of this peculiar little Polyzoon was attached to a piece of stick and was rather deeply buried in crevices between the ridges on the bark. It consisted of a single small colony apparently in a degenerate condition, and only a few of its zooecia and polypides are at all well preserved. I found it impossible, moreover, to gain more than a very general idea of the structure of the organism *in situ* and only succeeded in extracting and mounting two consecutive zooecia—evidently the two oldest zooecia in the colony—in such a condition as to illustrate their natural relationship one to another. Fortunately these two zooecia, and the polypides they contain, are well preserved, fully mature and in one case about to produce a resting bud. Their peculiarities are so well marked that I do not hesitate to accept them as the type of a new species.

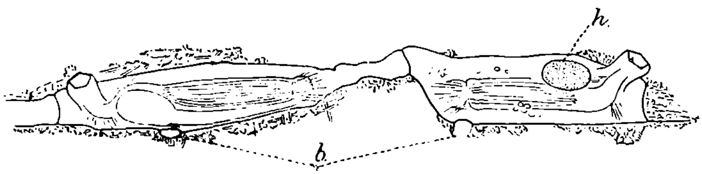


FIG. 6.—*Paludicella pentagonalis*, sp. nov., × 35.
Part of the type-colony seen in oblique lateral view.
b. = base of lateral bud. *h.* = resting bud.

Colony. The colony as observed consisted of a linear series of zooecia without lateral branches, but it is evident that lateral branches must have existed at some period in the history of the organism as the bases of the lateral buds can still be detected in mounted zooecia. Not more than half a dozen zooecia in all were present. The colony seems to have arisen from an embryo or bud that gave rise to two zooecia that were orientated in opposite directions (fig. 6).

Zooecia. The ectocyst of the zooecia is perfectly colourless and hyaline except on the orificial tubules, on which it is yellowish and considerably thickened. The zooecia are variable in shape and proportions but always flattened, relatively broad and more or less produced and narrowed proximally. They do not exceed 1·2 mm. in length.

The orifice is distinctly pentagonal. The orificial tubule is relatively long and subcircular in cross-section below the orifice. Its ectocyst sometimes exhibits a tendency to flake in such a way as to produce slender irregular processes that stand up vertically above the orifice when the polypide is retracted. Fig. 5*a*, pl. i, shows the structure of the orifice so far as it can be made out in the material at my disposal.

Polypide. The polypide has the structure normal in the genus, but is remarkable for the great length of the slender-walled oesophagus and for the broadly pear-shaped outline of the stomach, which occupies a relatively larger part of the space available in the zooecium. The tentacles are long and slender and probably number 16. The intestine is bulky. Funiculi cannot be seen in my specimen and I have not been able to detect the collar precisely.

Musculature. All the muscle-fibres are remarkably stout, especially those of the retractor muscles. The parietal muscles are short and entirely lateral in position. They are variable in number and arrangement. The "pyramidal" muscles connected with the orifice are attached to the retractile part of the ectocyst very low down and are arranged in three groups, two anterior (distal) and one posterior (proximal).

Gonads. One of my mounted zooecia contains a ripe testis. It consists of rather discrete groups of cells situated on the floor of the zooecium proximad of the stomach and some distance from the proximal end of the zooecium (pl. i, fig. 5).

Buds. The position of the primary lateral buds seems to be variable; sometimes they are situated much nearer the proximal end of the zooecium than is usual in *P. ehrenbergi* or *P. elongata.*

In one zooecium a young resting-bud occurs in the distal part of the zooecium. It consists of a broadly oval mass of rounded cells densely packed with food-granules. The upper surface is smoothly rounded, but below the outline seems to be irregular. A thin chitinous investment has already been deposited round it. The length is 0·1477 mm. and the greatest transverse diameter 0·102 mm. The polypide in this zooecium is not markedly degenerate.

Type. No. 7194/7 Z. E. V. in the register of the Indian Museum (Zool. Survey of India): mounted in Canada balsam on a slide.

Locality. Lampam, at the edge of Patalung R near its entry into the Talé Sap, Singgora Province, Peninsular Siam: January, 1916: in permanently fresh water.

The most striking feature of this new species is its pentagonal orifice, in which it resembles *Potsiella erecta*, Leidy. From that species, however, it differs entirely in the form of the zooecium, and, so far as can be seen at present, there is no reason for separating it from the genus *Paludicella*.

Family VICTORELLIDAE.

Genus **Victorella**, Kent.

1911. *Victorella*, Annandale, *Rec. Ind. Mus.* IV, p. 193.
1915. *Victorella*, Harmer, '*Siboga*'-*Exp.*, mon. XXVIII*a*. p. 44.

Most species of the genus are found habitually in brackish water on or near the coast, but the genus has been recorded from Lake Tanganyika in Central Africa, the Birket-el-Qûrun in Egypt and Issyk-kul in Central Asia. Loppens found the common European form (*V. pavida*, Kent) in marine oyster-beds on the coast of Belgium and

Harmer (*op. cit.*, p. 45) has ascribed to the genus a marine species (*V. sibogae*) from a depth of 0 and 32 metres in the Malay Archipelago.

All brackish-water species as yet examined have eight tentacles, but *V. sibogae* has probably more than twenty. Its generic position seems to me doubtful.

The genus is evidently cosmopolitan in distribution, but has not as yet been found in America. Definite records now exist from northern Europe, Egypt, Central Africa, Central Asia and India; a specimen was recently taken in the Main Island of Japan by Dr. A. Oka and myself.

Victorella bengalensis, Annandale.

(Pl. I, figs. 6, 7.)

1907. *Victorella pavida*, Annandale (*nec* Kent), *Rec. Ind. Mus.* I, p. 200, figs. 1-4.
1908. *Victorella bengalensis*, *id.*, *Rec. Ind. Mus.* II, p. 12, fig. 1.
1911. *Victorella bengalensis*, *id.*, *Faun. Brit. Ind.*, *Freshw. Sponges*, etc., pp. 191, 192, fig. 37 *a-f*; p. 170, fig. 31.
1911. *Victorella continentalis*, Braem, *Trans. Soc. Nat. St. Petersb.* LXII, p. 30, figs. 18-21.
1911. *Victorella bengalensis*, Annandale, *Rec. Ind. Mus.* VI, p. 197, pl. xiii, figs. 3, 7, 8.
1911. *Victorella symbiotica*, *id.* (? *nec* Rousselet), *ibid.*, p. 197, pl. xiii, fig. 6.
1915. *Victorella bengalensis*, *id.*, *Mem. Ind. Mus.* V, p. 125.

This species was abundant on sticks in the Talé Sap off Koh Yaw in January, 1916, in water that varied in specific gravity (corrected) from 1·00625 to 1·008. I can see no specific difference between specimens from India and Siam and others from the salt-lake Birket-el-Qûrun in Egypt. The latter seem to me to agree well enough with Rousselet's figure of *V. symbiotica* from L. Tanganyika, but Braem, who has examined examples from both African localities, states that there is a difference (which he refrains from describing) in the alimentary canal between the true *V. symbiotica* and the Egyptian form. As I have not examined specimens from Tanganyika and as Rousselet does not discuss or figure the anatomy in detail, I can express no opinion on this point but must content myself with reproducing a drawing of the alimentary canal of *V. bengalensis* (pl. i, fig. 7).

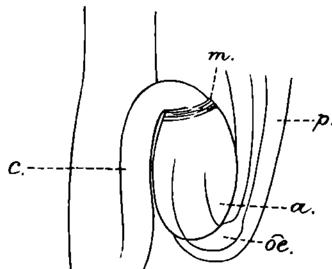


FIG. 7.—*Victorella bengalensis*.

Central region of the alimentary canal of a retracted polypide in lateral view (slightly diagramatic).

a = oval chamber with horny lining. *c.* = thick walled glandular tube. *m.* = circular muscle. *oe.* = oesophagus. *p.* = pharynx.

V. bengalensis, as I have pointed out elsewhere, is a very variable form; some colonies have larger zooecia and a thicker ectocyst than others, while environment appears to exert a direct effect on the growth and appearance of the colony. With the thickness of the zooecia the development of the parietal muscles is to some extent correlated. Specimens from Birket-el-Qûrun have very small and delicate zooecia. My Siamese examples on the other hand are particularly well developed in all cases; the length and greatest diameter of the largest zooecia are 2·55 and 0·272 mm. In a colony from the neighbourhood of Calcutta the largest zooecia are, however, only 1·615 long by 0·221 in diameter, while in one from Port Canning, some 30 miles distant, the measurements are 0·935 and 0·153. These differences appear to be considerable if individual colonies are compared, but they disappear completely in a long series of specimens.

In all my Siamese specimens the ectocyst is rather thick and has a slight yellowish tinge. The parietal muscles, though well developed in some zooecia, are not invariably stronger or more numerous than in specimens from India or Egypt. In some Siamese zooecia, however, they extend further up the zooecia than is usual in Indian examples.

Family HISLOPIIDAE.

1911. Hislopiidae, Annandale, *Faun. Brit. Ind., Freshw. Sponges*, etc., p. 199.
1911. Hislopiidae, *id.*, *Rec. Ind. Mus.* VI, p. 199.

Genus **Hislopia**, Carter.

I have now been able to examine ample material of all the forms hitherto described in this genus with the exception of *H. placoides* (Korotneff), and on my recent tour was fortunate in discovering a new species which, owing to the transparency of its ectocyst, the study of the anatomy was peculiarly easy. The following key to the species may, therefore, be of some value :—

I. Orifice armed with four very long spines .. ... *H. placoides.*
II. Orifice unarmed or bearing four short spines.
  A. Zooecia in uncongested parts of the colony almost circular, slightly truncated proximally and distally. Ectocyst yellowish, orifice quadrate or subquadrate, usually with four short spines .. *H. moniliformis.*
  B. Zooecia in uncongested parts of colony oval or ovoid.
    i. Ectocyst perfectly hyaline and colourless; terminal zooecia assuming a fan-like outline before becoming oval; no orificial spines. .. .. .. *H. malayensis.*
    ii. Ectocyst yellowish; terminal zooecia not passing through a fan-shaped stage.
      a. Zooecia (at any rate in peripherial parts of the colony) constricted and produced at the proximal end; the margins not noticeably thickened; orifice as a rule without spines *H. cambodgiensis.*
      b. Zooecia not or very rarely pedunculate; their margins thickened and chitinized; four short orificial spines frequently present .. *H. lacustris.*

All these species are closely related and in order to identify specimens satisfactorily it is necessary to examine the peripherial parts of the colony; the older zooecia, which of course occur towards the centre, are often distorted owing to congestion.

The genus *Hislopia* occurs over a great part of Asia. *H. placoides* is only known from Lake Baikal and *H. moniliformis* (originally described in my volume in the "Fauna" as a variety of *H. lacustris*) from ponds at Calcutta. *H. lacustris* is widely distributed in northern India and Burma and *H. cambodgiensis* in Indo-China, Siam and China; while the new species *H. malayensis* has been found as yet only in a small lake in the Siamese province of Patani in the north-east of the Malay Peninsula. I have recently observed what I take to be remains of a species of *Hislopia* on shells of the genus *Aetheria* from tropical Africa, probably from the Upper Nile; but these cannot be identified specifically.

Hislopia cambodgiensis (Jullien).

(Pl. I, fig. 8.)

1880. *Norodonia cambodgiensis* and *H. sinensis*, Jullien, *Bull. Soc. zool. France* V, pp. 77-79, figs.

I found in Chinese specimens, attached (like the types) to shells of freshwater molluscs, that the two forms described by Jullien in the paper cited passed insensibly one into the other, his *cambodgiensis* representing in fact merely older colonies, or the central congested part of old colonies, of his *sinensis*. I can find no difference between these forms and *H. lacustris*, the type-species of *Hislopia*, that would justify generic separation. Indeed, I have long hesitated whether to regard the differences that do exist as specific or as merely racial. In the collection of the Indian Museum there are specimens of *H. lacustris* on the shells of Unionidae and Viviparidae from *jhils* (swamps or shallow lakes) in northern Bengal the central or oldest zooecia of which agree almost exactly with those of the same kind in colonies from China. Moreover, the form of the orifice and the development of spines in connection with it are extremely variable characters in both the Indian and the Chinese forms. But while in the former the young zooecia are rarely if ever pedunculate, in the latter they are invariably so, thus having a very characteristic appearance (see pl. i, fig. 8). Other less important differences are the following:—

1. The colony of *H. lacustris* invariably forms, when fully developed, owing to profuse lateral budding, a solid pavement or layer, whereas in *H. cambodgiensis* lateral buds are produced much less sparingly, so that the colony consists of visibly radiating and separate branches.
2. In *H. lacustris* (and also in *H. moniliformis*) the margin of the zooecia is thickened and chitinized, whereas in *H. cambodgiensis* this is not at all or very indistinctly the case.
3. In *H. lacustris* some at any rate of the zooecia in each colony possess four well-developed but short spines at the four corners of the quadrate orifice, whereas in *H. cambodgiensis* the orifice is usually subcircular and spines are only occasionally developed in connection with it.

4. The chitinous lining of the gizzard is usually rather thicker in *H. cambodgiensis* than in *H. lacustris* and the thin-walled oesophagus perhaps rather longer.
5. In *H. cambodgiensis* the parietal muscles are, at any rate in the older zooecia, more powerful, consisting of more numerous and thicker muscle-fibres.

Jullien's description of *Norodonia* was apparently based on dried specimens, in which the central part of the roof of the zooecia, especially if they be young, as a rule collapses, giving a somewhat false idea of the natural appearance. The ectocyst becomes considerably thicker and darker in old zooecia than in young ones.

The orifice in this species is as a rule rather small and the orificial tubercle very low. The former is in most cases surrounded by an incomplete circular or subcircular horny ring, which is interrupted posteriorly. Occasional zooecia may be found in the older parts of colonies in which the ring is complete and subquadrate. More rarely it bears spines at its four corners, but one or more of the spines is usually abortive and I have not seen a case in which four well-developed spines were present.

Zooecia developing in the depressions between ridges on the epidermis of Unionid shells are frequently assymmetrical, as in the branch figured on pl. i.

The number and the arrangement of the parietal muscles are very variable, as is apparently the case in all species of the genus. The fibres seem to become stouter and more numerous as the ectocyst thickens with age. These muscles do not run parallel to the walls of the ectocyst as in *Paludicella*, *Victorella*, *Bowerbankia* and other more or less tubular forms, but directly from the floor to the roof at some distance from the sides of the zooecium, as in flattened forms such as *Alcyonidium*. In some cases they form a rather dense mass on either side of the polypide, but in young zooecia they are always very difficult to detect.

Localities, etc. Jullien found the two forms here regarded as synonymous on Lamellibranch shells from an island in the Mekong River on the borders of Siam and Cambodia, from the interior of Cambodia and from the neighbourhood of Canton and the province of Ngan-Honi in China. My own examples of the species are on shells from the south-east corner of the Tai-Hu (Great Lake) in the Kiangsu Province of China. They were taken in the channel west of the island of Tong-Dong-Ding and in the Moo-Too creek, on a muddy bottom in from 6 to 10 feet of water, in December, 1916.

All specimens as yet found have been on the shells of molluscs; my own were on those of *Anodonta woodiana* (Lea) the animals in which were alive.

Hislopia malayensis, sp. nov.

(Pl. I, fig. 9; pl. II, figs. 1, 1*a*.)

The species may be distinguished by the following diagnostic characters.

The *colony* is entirely adherent and of a more or less circular form, consisting of numerous primary branches that radiate from a common centre and give rise occasionally at an acute angle to lateral branches in the typical cruciform manner.

Adult *zooecia* are flattened, oval or ovoid and not or but very slightly pedunculate. Young terminal zooecia arise in the form of slender, pointed, flattened cylinders, which reach almost their full length and then expand fan-wise at the tip until they take the form of a comparatively long and narrow peduncle supporting a triangular or pentagonal head. The whole structure then gradually expands from in front backwårds until the adult oval or ovoid outline is assumed. The ectocyst is hyaline and colourless except round the orifice; the margins of the zooecium are not thickened but are surrounded by a narrow rim of flat membrane. The orificial tubercle is low. The orifice is surrounded on three sides by a brownish chitinous rim, which does not bear spines, though it is usually quadrate or subquadrate, and is broadly interrupted posteriorly or proximally.

I can find no definite diagnostic characters in the polypide or musculature. Both are admirably displayed in stained and mounted specimens (pl. i, fig. 9).

Type-specimens. No. 7152/7 Z.E.V., Ind. Mus. (Zool. Survey of India); in alcohol.

Locality, etc. Small lake at the base of a limestone hill (Bukit Jalor) in the inland state of Jalor or Yäla in the Siamese province of Patani in the eastern part of the Malay Peninsula. The specimens, which were taken in the first week of February, 1916, were growing on a dead palm-leaf that had fallen into the water. Specimens were also taken by Mr. H. C. Robinson and myself at the same place in 1901. They met with an accident that caused them to dry up and I identified them provisionally as *H. lacustris*.

The colony is as a rule less congested than in *H. lacustris* and *H. cambodgiensis*, if more luxuriant in its growth than *H. moniliformis*. This is mainly because lateral branches are sparingly, but not very sparingly, produced. The successive forms assumed by the young terminal zooecia are most characteristic. In the other species I have seen the buds often attain a considerable length as flattened cylinders, but seem to assume the adult form gradually. Even in *H. cambodgiensis*, in which adult zooecia are normally pedunculate, I cannot find any state comparable to those marked c, d and e on fig. 1*a*, pl. ii.

The parietal muscles are fully developed in this species and vary greatly in number of fibres and in arrangement. In the zooecium figured on pl. i they consist of a number of imperfectly grouped or solitary fibres scattered chiefly on the outer side of the polypide.

In specimens preserved in alcohol the roof of the zöoecium usually collapses to some extent and consequently these muscles are somewhat distorted or displaced.

The homologues of the pyramidal muscles of the orificial tubule in such genera as *Paludicella* consist of separate fibres grouped in a somewhat indefinite manner on each side of the orifice. It is not uncommon for them to be, as in the figure, markedly assymmetrical.

The polypide, as I have already stated, agrees closely with that of *H. lacustris*, the general structure of which is discussed and figured in the "Fauna." There is considerable variation in the proportions of the different parts of the alimentary canal. This is due partly to the different states of contraction in which different polypides are killed and partly to changes induced by growth and other physiological conditions.

There are apparently about 16 tentacles. In contracted specimens I cannot see the collar.

The star-shaped aperture by means of which a zooecium communicates with its parent and daughter zooecia are clearly defined and easily seen in this species (fig. 8A). There is no trace of a funiculus in connection with them. They are always surrounded by wandering cells, which may sometimes be seen actually over the aperture. The rays of the star-like aperture frequently bifurcate so as to produce a

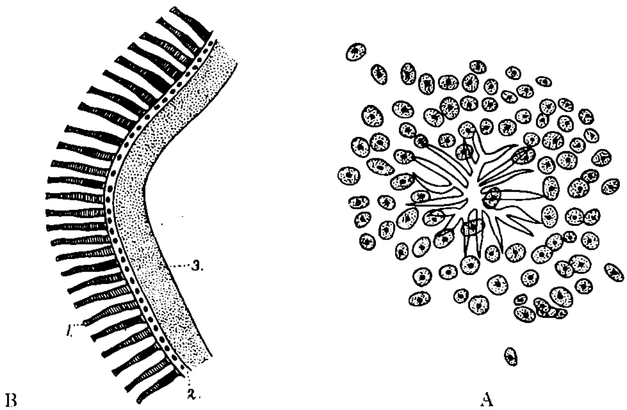


FIG. 8.—*Hislopia malayensis*, sp. nov.

A.—Orifice between two zooecia as seen from within distal zooecium, showing wandering cells (× 542). B.—Optical section of wall of circular chamber (× 542).

1 = circular muscle-fibre 2 = internal cellular layer. 3 = horny lining of chamber.

somewhat complicated figure. At the points at which buds are given off or a daughter zooecium is attached to its parent, the flat marginal membrane is interrupted and a short peduncle is developed to form the actual linking structure. When adjacent zooecia not originally connected are pressed together by the growth of the colony, as in the preparation figured on plate i, fig. 9, the membrane of the older or more vigorous zooecium often grows over the membrane or over a part of the roof of the younger or less vigorous.

The ovaries are scattered round the periphery of the zooecial chamber and each produces several ova. The testes probably occur similarly but are not developed in the preparations I have examined. It is possible that the colonies are unisexual.

EXPLANATION OF PLATE I.

CHITASPIS ATHLETICUS, gen. et sp. nov.

FIG. 1.—Lateral view of a part of the type-specimen, showing two polypiferous and parts or the whole of three non-polypiferous segments. One of the polyps has lost its capitulum. × 46·5.

ALCYONIDIUM MYTILI, Dalyell.

FIG. 2.—Retracted polypide from a specimen on a shell of *Potamides fluviatilis* from the Chilka Lake in Orissa. × *ca.* 84.

TRITICELLA PEDICELLATA (Alder).

FIG. 3.—Part of the rhizome of a specimen from the tail of the sea-snake *Enhydris hardwickii* from the Talé Sap, Peninsular Siam. × 101.

The stalks of the zooecia have been cut off near the base and have probably been somewhat compressed in the process.

PALUDICELLA ELONGATA, Leidy.

FIG. 4.—Right lateral view of a zooecium from the roots of a willow tree at the edge of the Moo-Too creek, Tai-Hu, Kiangsu Province, China. (Stained with borax carmine). × *ca.* 35.

PALUDICELLA PENTAGONALIS, sp. nov.

FIG. 5.—Left lateral view (slightly oblique) of a zooecium of the type-specimen. (Stained with borax carmine). × 67·5.

,, 5*a*.—Orifice and adjacent parts of another zooecia from the same colony. (Stained with borax carmine). × *ca.* 79.

VICTORELLA BENGALENSIS, Annandale.

FIG. 6.—A group of zooecia from a colony growing on a stick in the Talé Sap, Peninsular Siam. (Stained with borax carmine). × *ca.* 34.

,, 7.—Polypide (partly expanded) from colony from Port Canning, Gangetic delta. a = Cardiac antechamber. c = Cardiac limb of stomach. ca = Oesophageal valve. f = Funiculus. i = Intestine. m = Cardiac muscle. oe = Oesophagus proper. p = Pharynx. r = Rectum. s = Pyloric limb of stomach. t = Tentacles.

HISLOPIA CAMBODGIENSIS (Jullien).

FIG. 8.—Terminal part of a branch of a specimen growing on a living shell of *Anodonta* from the south-east part of the Tai-Hu, Kiangsu Province, China. × 22·5.

HISLOPIA MALAYENSIS, sp. nov.

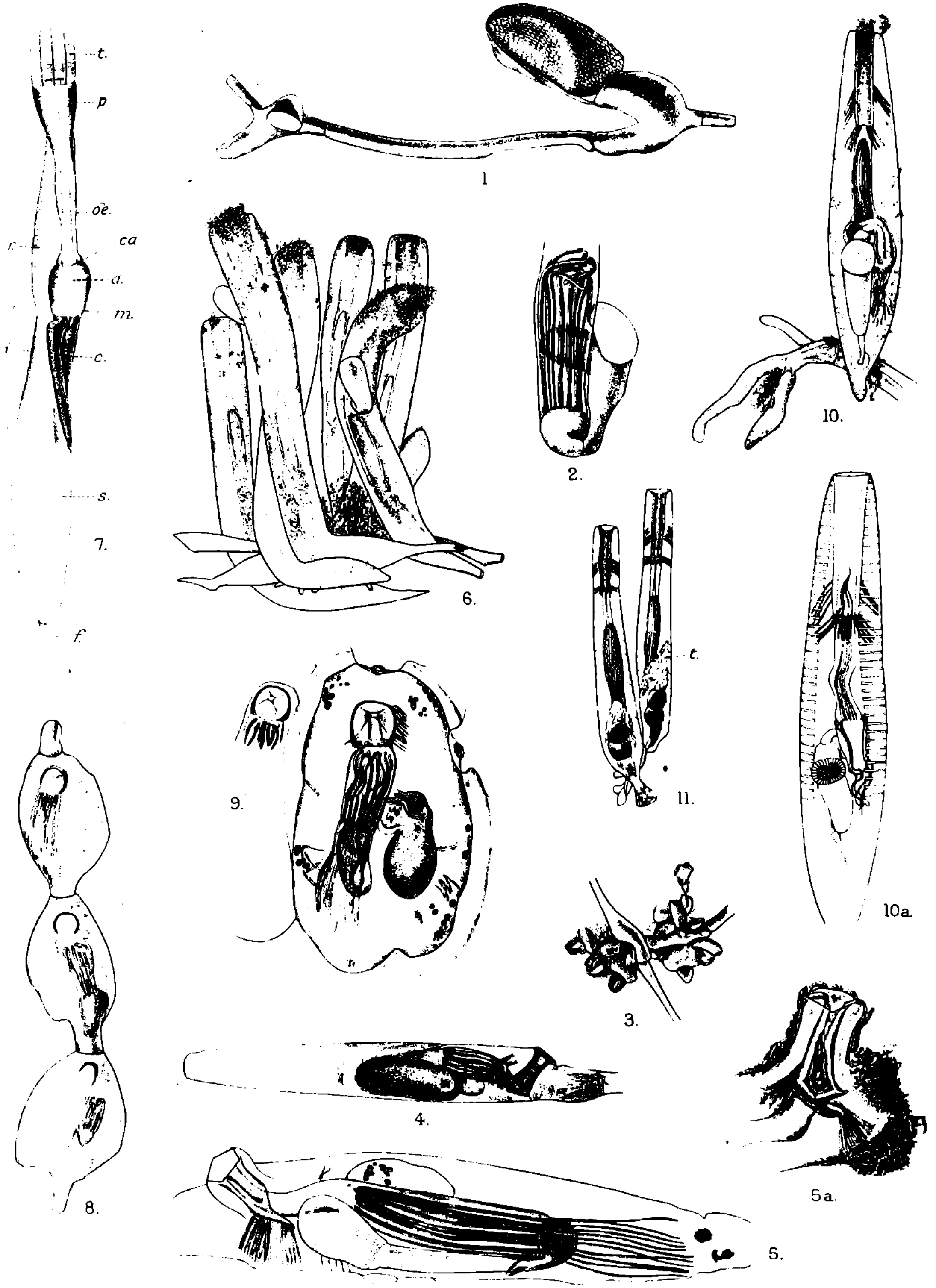
FIG. 9.—Zooecium from type-specimen. (Stained with borax carmine). × *ca.* 34.

BOWERBANKIA CAUDATA, Hincks.

FIG. 10.—Terminal zooecium of a colony from Port Weld, west coast of the Malay Peninsula. × *ca.* 34.

,, 10*a*.—Another zooecium from the same colony, showing parietal muscles, etc. (Stained with borax carmine). × *ca.* 34.

,, 11.—Two zooecia from a colony from the Talé Sap, Peninsular Siam, showing the expansion of the " tail " to form an organ of adhesion in one zooecium and its almost complete absence in another. × *ca.* 34. t=Testes.



D. N. Bagchi, del. Bemrose, Collo. Derby.

ENTOPROCTA AND CTENOSTOMATA.

EXPLANATION OF PLATE II.

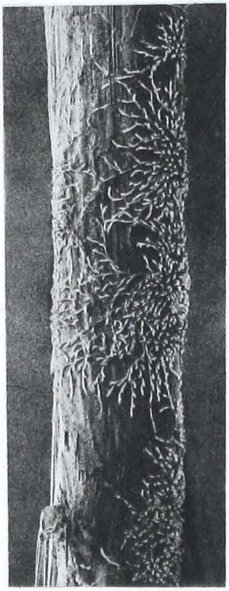
Photographs of Polyzoa and Sponges from Fresh and Brackish Water in the Malay Peninsula.

HISLOPIA MALAYENSIS, sp. nov.

FIG. 1.—Type-specimen (nat. size).

,, 1*a*.—Part of the same enlarged. a, b, c, d, e = young zooecia in different stages of development.

(The other figures in this plate will be explained in subsequent reports).



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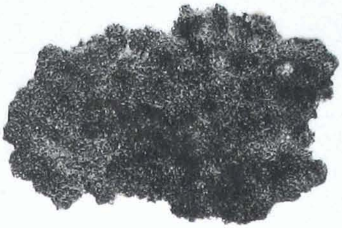

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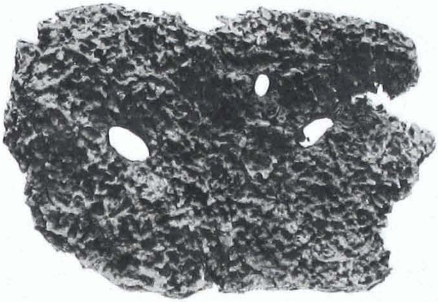

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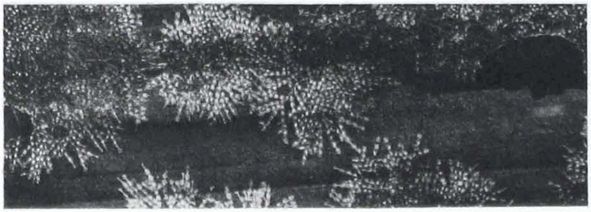

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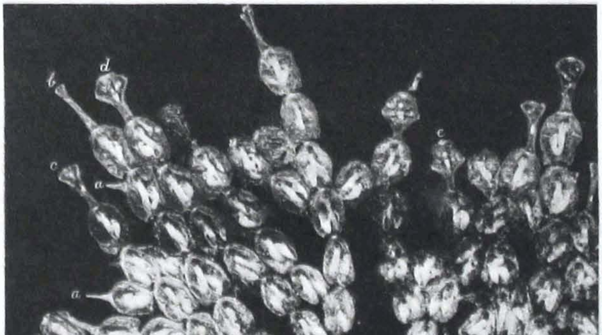

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Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

THE MOLLUSCA OF LAKE BIWA, JAPAN.

By N. ANNANDALE, *D.Sc., F.A.S.B.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

THE MOLLUSCA OF LAKE BIWA, JAPAN.

(Plate III.)

By N. ANNANDALE, *D.Sc.*, *F.A.S.B.* (*Zoological Survey of India*).

A pamphlet on the Mollusca of Lake Biwa, unfortunately for European readers in Japanese, has recently been published by the Fishery Department of the Shiga Prefecture, which maintains a well-equipped station near Hikoné on the eastern side of the lake. This pamphlet deals with the molluscs primarily from an economic point of view, several species (notably *Corbicula viola*) having considerable value as food, while others (in particular *Hyriopsis schlegeli*) are sought mainly on account of their pearls; but it also contains valuable information as to the distribution of various species in the lake and its immediate vicinity, and good photographs of shells are reproduced as well as a valuable map illustrating the local and bathymetric range of commercially useful genera. I have made use of extracts, which have been translated for me by Dr. T. Kawamura, as well as of the figures and map.

The pamphlet recognises only 21 species (8 of gastropods and 13 of lamellibranchs) as occurring in Lake Biwa and the surrounding pools, ditches and irrigated rice-fields. In the present paper 33 species are accepted as distinct, 15 of gastropods and 18 of lamellibranchs.

The reason for this difference is twofold—in the first place it is owing to the discovery of species either new to science or not recorded hitherto from the lake, and secondly to the fact that the anonymous authors of the Japanese memoir have in some cases paid no attention to differences in the shells that recent authorities regard as of specific importance. Mr. H. B. Preston [1] has described the new species discovered in the course of my own investigations or obtained by Dr. Kawamura, while Haas's as yet incomplete monograph of the Unionidae [2] has proved of great value in the identification of shells of that family.

The new species are either from deep water, in which they were obtained by means of a small dredge and a D-net on the bottom, or else from the lower surface of stones near the margin—a type of environment very profitable to the collector of Mollusca in lakes.

The following is a complete list of the known Mollusca of Lake Biwa according to the nomenclature accepted in this paper; the species whose names are marked with an asterisk are represented in my collection or in that of the late Dr. John

[1] *Ann. Mag. Nat. Hist.* (8) XVII, pp. 159-163 (1916).

[2] Die Unioniden in Chemnitz's *Syst. Conch. Cab.* (new. edit.) IX, ii, 2 (1911—).

Anderson.[1] Both collections have been presented to the Indian Museum, in which the type specimens from my own will be preserved.

List of the Aquatic Mollusca of Lake Biwa.

GASTROPODA.

Fam. Succineidae.
*Lithotis japonica**, *Preston.*

Fam. Limnaeidae.
*Limnaea pervia**, v. Martens.
*Limnaea japonica**, Jay.
*Choanomphalus japonicus**, Preston.
Ch. japonicus var. *perstriatulus**, Preston.
Planorbis (*Gyraulus*) *biwaënsis*,* Preston.

Fam. Melaniidae.
*Melania libertina**, Gould.
*Melania multigranosa**, Bttgr.

Fam. Melaniidae (*contd.*)
*Melania niponica**, Smith.
*Melania biwae**, Kobelt.

Fam. Hydrobiidae.
*Bithynia striatula japonica**, Pilsbry.

Fam. Viviparidae.
*Vivipara japonica**, v. Martens.
*Vivipara malleata**, Reeve.
*Vivipara sclateri**, Ffld.

Fam. Valvatidae.
*Valvata biwaënsis**, Preston.
*Valvata annandalei**, Preston.

LAMELLIBRANCHIATA.

Fam. Unionidae.
*Hyriopsis schlegeli** (v. Martens).
*Cristaria plicata** (Leach).
*Cristaria spatiosa** (Clessin).
*Pletholophus reiniana** (v. Martens).
*Anodonta woodiana** (Lea).
*Anodonta calipygos**, Kobelt.
*Lanceolaria bilirata** (v. Martens).
*Lanceolaria oxyrhyncha** (v. Martens).
*Nodularia japanensis** (Lea).

Fam. Unionidae (*contd.*)
*Nodularia biwae** (Kobelt).
*Nodularia reiniana** (Kobelt).
*Nodularia hirasei**, Haas.
Nodularia parcedentata, Haas
Pseudodon loomisi, Simpson.

Fam. Cyrenidae.
*Corbicula sandai**, Reinhdt.
*Corbicula viola**, Pilsbry.
*Sphaerium heterodon**, Pilsbry.
*Pisidium casertanum** (Poli).

Part I. SYSTEMATIC.

GASTROPODA.

Family SUCCINEIDAE.

Genus **Lithotis**, Blanford.

1863. *Lithotis* (subgenus of *Succinea*), Blanford, *Ann. Mag. Nat. Hist.* (3) XII, p. 186.
1914. *Lithotis*, Gude, *Faun. Brit. Ind.*, Moll. II, p. 457.

Except for the Japanese form, the true affinities of which are doubtful, this genus has been recorded hitherto only from the west-central part of Peninsular India.

[1] See Möllendorff, *Journ. As. Soc. Bengal* LIV (2), pp. 59-68 (1885).

Lithotis japonica, Preston.

(Pl. III, fig. 1.)

1916. *Lithotis japonica*, Preston, *Ann. Mag. Nat. Hist.* (8) XVII, p. 160, pl. ix, figs. 6, 6a.

Colonel Godwin-Austen writes that he is very doubtful of the generic identity of this species with the Indian forms, which seem to be amphibious rather than strictly aquatic in habits.

The Japanese mollusc is found clinging tightly to the lower surface of stones in shallow water. It is not uncommon at Chikubushima, and I took a specimen at Zézé near Otsu. A dead shell was also dredged in the middle of the southern part of the lake. The animal as a rule insinuates itself into small concavities on the surface of the stone in such a way that its shell fits close and becomes extremely inconspicuous.

Family LIMNAEIDAE.

Genus **Limnaea**, Lamarck.

Limnaea pervia, v. Martens.

1879. *Limnaea pervia*, Kobelt, *Abh. Senckenberg. nat. Ges.* XI, p. 389, pl. xv, figs. 5, 6.
1885. *Limnaeus pervius*, Möllendorff, *Journ. As. Soc. Bengal* LIV (2), p. 66.
1886. *Limnaeus pervia*, Clessin in Chemnitz, *Syst. Conch. Cab.* (*ed.* Kuster) I, pt. XVII, Limneiden, p. 388, pl. liii, fig. 6.

This species appears to be scarcer in the vicinity of Lake Biwa than *L. japonica*. A small specimen was taken among weeds in shallow water in the southern part of the lake and a larger one in a ditch at Hikoné

The species was originally described from N. China and has been recorded from Tokyo (Yedo).

Limnaea japonica, Jay.

1879. *Limnaea japonica*, Kobelt, *op. cit.*, p. 390, pl. xv, figs. 2-5.
1886. *Limnaeus japonicus*, Clessin, *op. cit.*, p. 382, pl. lii, fig. 6.
1887. *Limnaeus japonicus*, Möllendorff, *op. cit.*, p. 66.

I did not find this species in Like Biwa, but it is abundant in ditches and rice-fields at Hikoné on the eastern shore and doubtless at other places in the neighbourhood.

It is known from Hokkaido and Shikoku as well as from the Main Island of Japan.

Genus **Choanomphalus**, Gerstfeldt.

1909. *Choanomphalus*, Lindholm in Korotneff's *Wiss. Ergebn. Zool. Exp. Baikal-See* IV (Mollusken), pp. 8, 93.

The genus was at one time regarded as peculiar to Lake Biwa. According to Lindholm, however, it has also been reported from other parts of Siberia, from Thessaly and Macedonia, while there are species attributed to *Planorbis* from both western Asia and America that may possibly belong to it.

Choanomphalus japonicus, Preston.

1916. *Choanomphalus japonicus*, Preston, *op. cit.*, p. 160, pl. ix, figs. 2, 2a-2c.
1916. *Choanomphalus japonicus* var. *perstriatulus*, Preston, *op. cit.*, p. 161, pl. ix, figs. 1, 1a-1c.

This species and its variety *perstriatulus* are apparently not uncommon on the lower surface of stones at the south end of Lake Biwa. They are not known from any other locality.

Genus **Planorbis**, Guettard.

Planorbis (Gyraulus) biwaensis, Preston.

1916. *Planorbis (Gyraulus) biwaensis*, Preston, *op. cit.*, p. 161, pl. ix, figs. 3, 3a-3c.

Planorbis (*Gyraulus*) *biwaensis* also occurs in considerable numbers, but not very abundantly, on the lower surface of stones at the south end of Lake Biwa and is not yet known elsewhere.

Family MELANIIDAE.

Genus **Melania**, Lamarck.

Melania libertina, Gould.

1879. *Melania libertina*, Kobelt, *op. cit.*, p. 412, pl. xviii, figs. 2-8 ; pl. xix, figs. 2-5, 8.
1879. *Melania retifera*, *id.*, *op. cit.*, p. 416.
1874. *Melania libertina*, Brot in Chemnitz, *Syst. Conch. Cab.* (*ed.* Kuster) I, pt. XXIV (*Melaniaceen*), p. 59, pl. vi, fig. 14.
1874. *Melania retifera*, *id.*, *op. cit.*, p. 60, pl. vi, fig. 16.
1902. *Melania libertina*, Pilsbry, *Proc. Acad. Nat. Sci. Phil.* LIV, pp. 119, 120.

At least two colour-forms of this species occur in the neighbourhood of Lake Biwa. One of these, which corresponds both in colour, in sculpture and in size with *M. retifera*, Tryon, is fairly abundant on stones in shallow water at the south end of the lake. A much larger but otherwise similar form occurs in ditches near Sakamoto on the hills above the western shore. In ditches and irrigation channels near the fishery station at Hikoné on the eastern shore I found a large and very dark form, apparently the *forma typica* of the species. Young specimens of this form differ in colour from *retifera*, being not only darker but lacking all trace of reddish bands.

The species appears to be distributed throughout Japan, from Hokkaido to Formosa. It has many phases and varieties.

Melania multigranosa, Bttg.

(Pl. III, fig. 2, A—E.)

1874. *Melania niponica*, Brot, *op. cit.*, p. 338 (in part), pl. xxxiv, fig. 10a (*not* 10).
1879. *Melania niponica*, Kobelt, *op. cit.*, p. 415, pl. xix, figs. 5-7, 10-14.
1886. *Melania* (*Semisulcospira*) *multigranosa*, Boettger, *Jb. d. Malak. Ges.* XIII, p. 7.
1902. *Melania multigranosa*, Pilsbry, *op. cit.*, pp. 119, 120.

This species is one of the commonest molluscs in the lake and occurs both among weeds and on a clean sandy or muddy bottom at practically all depths. We took two large and much eroded shells at a depth of about 41 fathoms; these were the stoutest examples I saw. At some places in the lake, for what reason I am unable to say, all the shells appeared to be dwarfed, but the external sculpture is not correlated in any way with environment. The species is extremely variable in this respect.

The typical form has been found only in Lake Biwa, but specimens of "var. *minor*, Smith," the identity of which is very doubtful, have, according to Brot, been recorded from Formosa by Möllendorff.

Melania niponica, Smith.

(Pl. III, fig. 3, A, B.)

1874. *Melania niponica*, Brot, *op. cit.*, p. 338 (in part), pl. xxxiv, fig. 10.
1902. *Melania niponica*, Pilsbry, *op. cit.*, p. 119.
1902. ? *Melania japonica*, *id.*, *op. cit.*, p. 120 (? *lapsu*).

Although this species closely resembles *M. biwae*, Kobelt, it is easily distinguished by the structure and form of the mouth of the shell (see pl. III, figs. 3, A, B).

M. niponica is only found on rocks or stones, on which it is very abundant. The typical form occurs with *M. libertina* on small stones at the south end of the lake, but at Chikubushima and other places where rocks descend vertically into the water to considerable depths, a much larger and more deeply sculptured phase occurs in great abundance. Specimens from small stones on the landing stage at Chikubushima provide, however, an almost complete transition between the two phases.

The species is only known from Lake Biwa.

Melania biwae, Kobelt.

(Pl. III, fig. 4.)

1879. *Melania biwae*, Kobelt, *op. cit.*, p. 416, pl. xix, fig. 9.
1902. *Melania biwae*, Pilsbry, *op. cit.*, pp. 119, 120.

This species is found on the rocks at Chikubushima with *M. niponica*. It is apparently scarce, but its resemblance to *M. niponica* has probably led to much confusion.

It is only known from Lake Biwa.

Family HYDROBIIDAE.

Geuns **Bithynia,** Gray.

Bithynia striatula var. **japonica,** Pilsbry.

1901. *Bithynia striatula* var *japonica*, Pilsbry, *Proc. Acad. Nat. Sci. Phil.* LIII, p. 405.
1902. *Bithynia striatula* var. *japonica*, *id.*, *ibid.*, LIV, p. 121, pl. ix, figs. 9-12.

Two specimens taken on a stone at the edge of the lake near Zézé agree exactly with Pilsbry's figure 9 of a specimen from Hidachi. The form is probably not really lacustrine: my examples were taken in a backwater almost separated from the lake.

The subspecies is only known from a few localities in the Main Island of Japan, in which it is widely distributed; Lake Biwa being near the middle of the known range. The typical form is found in China and Cambodia. Heude[1] says it is common in all the lake systems of the Blue River.

[1] *Mém. Nat. Hist. L'Emp. Chinois*, I, *Moll. d'eau douce*, p. 171, pl. xlii, figs. 11, 11a (? 1882).

Family VIVIPARIDAE.

Genus **Vivipara**, Lamarck.

Vivipara japonica, v. Martens.

1879. *Paludina japonica*, Kobelt, *op. cit.*, p. 404, pl. xi, fig. 1.
1897. *Paludina oxytropis* var. *japonica*, Iwakawa, *Annot. Zool. Japon.* I, p. 88, pl. v, fig. 17.
1902. *Viviparus japonicus*, Pilsbry, *Proc. Acad. Nat. Sci. Phil.* LIV, p. 117, pl. ix, fig. 1.
1909. *Vivipara japonica*, Kobelt in Chemnitz, *Syst. Conch. Cab.* (*ed.* Kuster) I, pt. XXI (2), *Paludina*, p. 99, pl. xv, figs. 1-4.

This is not a lacustrine form, though it may perhaps be occasionally found in the lake. It is abundant in rice-fields near Hikoné

Pilsbry records the species from Yamashiro, and Iwakawa from Kikuchu in the north-eastern part of the Main Island.

Vivipara malleata, Reeve.

1879. *Paludina stelmaphora*, Kobelt, *op. cit.*, p. 406, pl. xi, figs. 4, 5.
1897. *Paludina stelmaphora*, Iwakawa, *op. cit.*, p. 85, pl. v, figs. 1-4.
1902. *Viviparus malleatus*, Pilsbry, *op. cit.*, p. 116, pl. ix, figs. 6, 7.
1909. *Vivipara malleata*, Kobelt, *op. cit.*, p. 104, pl. xv, figs. 8, 9; pl. xvii, figs. 8-13.

V. malleata is an inhabitant of small pools of water ; it is very common in those round the Miidera monasteries on the hill behind Otsu. I saw no specimens in the lake.

It is widely distributed in Japan, from the extreme north of the Main Island to the Liu-Kiu Is. and Formosa, and is closely related to the Chinese *V. stelmaphora*, with which it was formerly identified by some authors.

Vivipara sclateri, Ffld.

1879. *Paludina ingallsiana*, Kobelt, (nec Reeve), *op. cit.*, p. 408, pl. **x**, figs. 14-18 ; pl. xi, fig. 2.
1897. *Paludina ingallsiana*, Iwakawa, *Annot. Zool. Japon.* I, p. 86, pl. v, figs. 5-7.
1902. *Viviparus sclateri*, Pilsbry, *op. cit.*, p. 118, pl. ix, fig. 4.
1909. *Vivipara sclateri*, Kobelt, *op. cit.*, p. 102, pl. xvi, figs. 1-9 ; pl. **xvii**, figs. 1-5.

This is one of the commonest molluscs of the lake, occurring both among weeds and on a bare bottom with *M. multigranosa*, *Corbicula viola*, etc. We took specimens at a depth of about 43 fathoms.

We have in the Indian Museum specimens from the late Dr. J. Anderson's Japanese collection labelled "*Paludina pseudoingallsiana*, Nevill," but this appears to be a *nomen nudum*.

The known range of the typical form of the species embraces the central part of the Main Island of Japan. There is some doubt as to the varieties that have been described and Pilsbry is of the opinion that *V. sclateri* may be no more than a variety of *V. histricus*, which is known from Kagoshima to the south.

Family VALVATIDAE.

Genus **Valvata**, Müller.

Valvata biwaensis, Preston.

(Pl. III, fig. 5.)

1916. *Valvata biwaensis,* Preston, *op. cit.*, p. 161, pl. ix, figs. 4, 4*a*.

V. biwaensis occurs abundantly on a muddy bottom in the deeper part of Lake Biwa. It is not known from any other locality, but does not appear to differ greatly from the only other species (except the closely allied *V. annandalei*) recorded from Japan. This species (*V. japonica*, v. Martens), which has not been figured, was described from a single specimen taken in Hakoné lake, a much smaller but deeper body of water situated near the Pacific coast of the Main Island of Japan not far from Sagami Bay.

Valvata annandalei, Preston.

(Pl. III, fig. 6.)

1916. *Valvata annandalei,* Preston, *op. cit.*, p. 162, pl. ix, figs. 5, 5*a*, 5*b*.

V. annandalei occurs with *V. biwaênsis*, but not so abundantly. It is perhaps no more than a variety of the other; so far as general form is concerned I have seen many intermediate shells, but the differences in sculpture appear to be constant.

LAMELLIBRANCHIATA.

Family UNIONIDAE.

Genus **Hyriopsis,** Conrad.

1900. *Hyriopsis,* Simpson, *Proc. U. S. Nat. Mus.* XXII, p. 578.

The genus is widely distributed in the mainland of south-eastern Asia, from Siam to eastern China, and occurs in Borneo. Only one species is found in Japan.

Hyriopsis schlegeli (v. Martens).

1879. *Unio schlegeli,* Kobelt, *Abh. Senckenber. nat. Ges.* XI, p. 421, pl. xiv.
1900. *Hyriopsis schlegeli.* Simpson, *op. cit.*, p. 581.

This species is fished, chiefly on account of its pearls, at several places on the east side of Lake Biwa in moderately deep water. It is apparently endemic in Japan, but I cannot find any particulars of its general distribution.

Genus **Cristaria,** Schumacher.

1900. *Cristaria,* Simpson, *op. cit.*, p. 583.

The genus (*s.s.*) is known from three species, two of which are recorded from Japan. Both of these are represented in my collection from Lake Biwa. One of them occurs also in the Amur district and in China and Cambodia, while the other is endemic in Japan. The third species (*C. herculea*, Middendorff) is found in eastern Siberia, the Amur region and north China. The genus as a whole has, therefore, a more northerly distribution than *Hyriopsis.*

Cristaria plicata (Leach).

(Pl. III, figs. 7, 8.)

1879. *Dipsas plicata* (*s.s.*), Kobelt, *op. cit.*, p. 429, pl. xvi; pl. xviii, fig. 1.
1879. *Dipsas plicatus*, Heude, *Conch. Fluv. Nanking* V, pls. xxxiii, xxxiv.

The species has a considerable synonomy (see Simpson, *op. cit.*) and appears, to judge from Heude's plates in the *Conch. Fluv. Nanking*, to reach a larger size in parts of China[1] than it does in Lake Biwa. In Japan it is often confused with *H. herculea*, which does not occur there, and with *C. spatiosa* and *Pletholophus reiniana*. Kobelt's pl. xvii represents *C. spatiosa*.

The shell of *C. plicata* undergoes considerable changes in form in the course of its growth. Adult and half-grown specimens are well figured by Kobelt on his plates xvi and xviii; photographs of still younger shells are reproduced (natural size) on pl. III, figs. 7, 8 of this paper. Young individuals were dredged from a depth of over 40 fathoms, but were also found in 5 fathoms.

C. plicata has a wide range in north-eastern Asia and occurs also in Cambodia. It is common in Japan, where it is fished for its pearls and as food.

Cristaria spatiosa (Clessin).

1879. *Dipsas plicata* var. *japonica*, Kobelt, *op. cit.*, p. 431, pl. xvii.
1900. *Cristaria spatiosa*, Simpson, *op. cit.*, p. 584.

This species seems to be less common in Lake Biwa than *C. plicata*. We obtained several specimens from a large pool at Komatsu on the western shore of the lake. It is probably a shallow-water form and is only known from Japan.

Genus **Pletholophus**, Simpson.

1900. *Pletholophus* (subgenus of *Cristaria*), Simpson, *op. cit.*, p. 585.

This group of species is regarded by Simpson as a subgenus of *Cristaria*, but is distinguished by the vestigial hinge-teeth of its shell. The species occur in Cambodia, Tonkin, China, Formosa and Japan.

Pletholophus reiniana (v. Martens).

1875. *Cristaria reiniana*, v. Martens, *Jb. d. Malak. Ges.* II, p. 136, pl. iii, fig. 1.
1900. *Cristaria reiniana*, Simpson, *op. cit.*, p. 585.

It is doubtful whether Kobelt's description and figures (*op. cit.*, p. 432, pl. xii, fig. 4; pl. xxii, fig. 2) represent this species. My own shells are relatively much broader; superficially they are not unlike those of *Cristaria spatiosa*. They are from a pool at Komatsu. The true *P. reiniana* is found only in Japan.

Genus **Anodonta**, Lamarck.

1900. *Anodonta*, Simpson, *op. cit.*, p. 620.

The genus (*s. l.*) is widely distributed in the Palaearctic and Nearctic Regions. A few species penetrate into the outlying districts of the Oriental Region, but none

[1] Shells are used in the neighbourhood of Soochow as bailers in fishing-boats.

occur in Africa or South America. Both the species to be considered here belong to Simpson's "Group of *A. woodiana*" (*op. cit.*, p. 637), which is confined to Tonkin, China and Japan.

Anodonta woodiana (Lea).

(Pl. III, figs. 9*a*, 9*b*.)

1900. *Anodonta woodiana*, Simpson, *op. cit.*, p. 637.

This species has an extensive synonomy (see Simpson). I am doubtful whether the specimen referred to it by Kobelt (*op. cit.*, pl. xx, fig. 1) really belongs to it and Simpson (*op. cit.*, p. 630) is not convinced that it occurs in Japan; but I have a specimen from Seta at the south-east of Lake Biwa that is only distinguished from Chinese examples from the Tai-Hu by the darker shade of its epidermis and of the margin of the inner surface. A valve of this specimen is figured on plate III. It was taken with examples of *A. calipygos* and differs from Kobelt's figure in being relatively broader, shorter and more tumid, and in having the anterior margin shorter and the posterior part of the shell more produced.

A. woodiana is widely distributed in China, Cambodia and Siam. Possibly it also occurs in the Amur region, but it appears to be mainly a southern form.

Anodonta calipygos, Kobelt.

1879. *Anodonta calipygos*. Kobelt, *op. cit.*, p. 435, pl. xix, fig. 1.
1900. *Anodonta calipygos*, Simpson, *op. cit.*, p. 641.

This is the common *Anodonta* of Lake Biwa. I took specimens at Seta and off Komatsu, at both places in shallow water. It is, I believe, common at Hikoné in ditches at the fishery station and is used there for feeding fish; but I have not examined specimens at all closely from that locality.

The species is only known from Japan, but the locality of the type-specimen is not stated precisely.

Genus **Lanceolaria**, Conrad.

1900. *Lanceolaria* (section of *Nodularia*), Simpson, *op. cit.*, p. 806.
1911. *Lanceolaria*, Haas, *Die Unioniden* in Chemnitz, *Syst. Conch-Cab.* (new edition) IX. ii (2), p. 43

This genus is peculiar to Tonkin, China, the Amur region and Japan. Two species occur in Japan, both of which are represented in my collection from Lake Biwa.

Lanceolaria bilirata (v. Martens).

1911. *Lanceolaria bilirata*, Haas, *op. cit.*, p. 55, pl. iv, figs. 3-5.

The species was originally described from Tonkin, but Haas has figured a shell from Japan. I did not distinguish it from *L. oxyrhyncha* while at Lake Biwa, but subsequently found several specimens in my collection. One was taken in the channel east of Oki-no-shima on a muddy bottom of from 2 to 4 fathoms.

Lanceolaria oxyrhncha (v. Martens).

1861. *Unio oxyrhynchus*, v. Martens, *Mal. Blatt.* VII, p. 57.
1879 *Unio oxyrhynchus*, Kobelt, *Abh. Senckenber. nat. Ges.* XI, p. 420, pl. xiii, figs. 3, 4.
1900. *Nodularia oxyrhynchus*, Simpson, *Proc. U. S. Nat. Mus.* XXII, p. 807.
1911. *Lanceolaria oxyrhyncha*, Haas in Chemnitz, *Syst. Conch. Cab.* (new edition) IX, ii (2), p. 53, pl. iv, figs. 1, 2.

I have several small specimens from Lake Biwa. The species has been found only in Japan, but its distribution in that country is imperfectly known.

Genus **Nodularia**, Conrad.

1911. *Nodularia*, Haas, *op. cit.*, p. 65.

I follow Haas as to the limits of the genus, from which he excludes all the Indian forms assigned to it by Simpson [1] and Preston.[2] Thus restricted *Nodularia* includes only 20 species, all of which are found in Japan, China or the Indo-Chinese countries, or in more than one of these.

Nodularia biwae (Kobelt).

1879. *Unio biwae*, Kobelt, *op. cit.*, p. 425, pl. xv, figs. 2-4.
1911. *Nodularia biwae*, Haas, *op. cit.*, p. 94, pl. ix, figs. 6-8.

This species is only known from Lake Biwa, in which it is one of the commonest forms. It is found in water less than 100 feet deep.

Nodularia reiniana, Kobelt.

1879. *Unio reinianus*, Kobelt, *op. cit.*, p. 424, pl. xv, fig. 1.
1911. *Nodularia reiniana*, Haas, *op. cit.*, p. 97, pl. x, fig. 1.

According to Haas, this species is widely different from all others except *N. hirasei*, which he thinks may be no more than a lacustrine form of it. Both, however, occur in the lake. I have some reason to think that *N. reiniana* lives in rather deeper water than *N. hirasei*, or perhaps on a more muddy bottom, but my evidence is by no means conclusive. The shell of *N. reiniana*, which is only known from Lake Biwa, seems to be peculiarly subject to erosion in the umbonal region.

Nodularia japanensis (Lea).

1879. *Unio japanensis*, Kobelt, *op. cit.*, p. 423. pl. xii, figs. 1, 2.
1911. *Nodularia japanensis*, Haas, *op. cit.*, p. 85, pl. viii, figs. 5-8.

Haas has figured specimens from Lake Biwa and from Tokyo (Yedo). The series in my collection from the lake shows great variation both in sculpture and in outline and seems to me to include forms intermediate between the *forma typica* and the variety *yokohamensis*, v. Jhering. The latter came from Yokohama, which is only a few miles from Tokyo.

The species is common in Lake Biwa. According to Haas it is related to the polymorphic *N. douglasiae*, various races of which are scattered in China and Japan.

[1] *Op. cit.*, pp. 806-827 (1900).

[2] *Faun. Brit. Ind., Freshw. Moll.*, pp. 135-148 (1915).

Nodularia hirasei, Haas.

1911. *Nodularia hirasei*, Haas, *op. cit.*, p. 95, pl. xii*a*, figs. 1, 2.

The type specimen of this species, which was only described in 1911, came from Yamashiro, a short distance south-west of Lake Biwa. It is by no means uncommon in the lake.

Family CYRENIDAE.

Genus **Corbicula**, Megerle v. Mühlfedt.

1907. *Corbicula*, Pilsbry, *Annot Zool. Japon.* VI, p. 153.

Corbicula sandai, Reinhardt.

(Pl. III, fig. 12.)

1904. *Corbicula sandai*, Fischer and Dautzenberg, *Miss. Pavie Indo-Chine, ét. div.*, III, p. 442.
1907. *Corbicula sandai*, Pilsbry, *op. cit.*, p. 157, pl. vii, figs. 17, 18.

The name *C. sandai* is usually applied to the common *Corbicula* of Lake Biwa, which provides a well-known food-product. I believe this, however, to be incorrect, for I was able to find very few specimens in the lake in which the ribs were not developed on the median portion of the valve—a character that Pilsbry regards as of prime importance in distinguishing *C. sandai* from his *C. viola*. The only specimens in my collection that have this character were taken in the channel east of Oki-no-shima at a depth of between 2 and 3 fathoms. They are small, the largest shell being 13 mm. long and 13·3 mm. high. Their outer surface is pale olivaceous stained with black. The inner surface is whitish stained with pale violet on the hinges and with brown on the lower margin.

The true *C. sandai* is not known north of Lake Biwa, but has a wide distribution in the southern islands of Japan proper. It has also been recorded from Tonkin (see Fischer and Dautzenberg).

Corbicula viola, Pilsbry.

(Pl. III, fig. 12.)

1907. *Corbicula viola*, Pilsbry, *op. cit.*, p. 158, pl. vii, figs. 7-10.

I have no doubt that this is the common species of Lake Biwa, but Pilsbry had not specimens of the largest size before him in drawing up his description. My largest shell is 31 mm. long, 28 mm. high, and 18 mm. thick when the two valves are together. Shells of this size are very asymmetrical and have the posterior end much produced and distinctly truncate. The nymph and the inner surface of the upper cavity often have a peculiar coral-pink colour and the extreme lower margin is tinged with brown. Both the exact shape of the shell and the breadth of the nymph vary considerably. The external surface is stained with black. Small shells are more symmetrical, less brilliantly coloured inside and brighter externally, often bearing concentric and alternating pale and dark bands.

The typical form is found in Lake Biwa at depths of from about 2 to 25 fathoms, as a rule on a sandy bottom. In the deeper part of the lake, on a muddy bottom in about 43 fathoms, I took a few specimens of what appears to be a dwarfed form. The largest shell is 11 mm. long, 11 mm. high, and 8 mm. thick with the two valves together. It is both relatively shorter and more globose, as well as being more symmetrical than the typical form; the hinge-structure is identical. I consider these shells dwarfed and not merely young because they are relatively shorter, as well as being thicker, than young shells of the typical form. The colour of the inner surface is also darker. Externally the shells are pale olivaceous green stained with a darker shade and with obscure narrow vertical rays of a reddish tinge.

A very peculiar polyzoon of the genus *Paludicella* is often found growing on the posterior end of the shells of this species, while the sponge *Spongilla clementis* not infrequently settles on the same part of the shell and sometimes suffocates the animal by its growth.

C. viola is only known from Lake Biwa.

Genus **Sphaerium**, Scopoli.

1901. *Sphaerium*, Pilsbry, *Proc. Acad. Nat. Sci. Phil.* LIII, p. 406.

According to Pilsbry, all the Japanese species of this genus, of which only four are at present known, belong to the subgenus *Calyculina*.

Sphaerium heterodon, Pilsbry.

(Pl. III, fig. 13.)

1901. *Sphaerium heterodon*, Pilsbry, *op. cit.*, p. 406.

I have not been able to refer to the original description of this species in Pilsbry's *Cat. Mar. Moll. Jap.*, but from the same author's remarks in the paper quoted above and from the figure given in the pamphlet on the Mollusca of Lake Biwa published by the Shiga Fishery Department, I take the form commonly found in the district to be *S. heteorodon*.

I did not find any specimens of *Sphaerium* in Lake Biwa, but obtained a fair series from ditches in the fishery station at Hikoné. The species was orginally described from the northern part of Kiushu, the most southerly of the larger islands of Japan proper. It has not, so far as I am able to say, been found further north than Lake Biwa.

Genus **Pisidium**, Pfeiffer.

1913. *Pisidium*, B. B. Woodward, *Cat. Brit. Pisidium Brit. Mus.*, p. 31.

Only two species of this Holarctic genus have as yet been found in Japan, namely *P. japonicum*,[1] Pils. & Hir. from a lake in Hokkaido and *P. casertanum* (Poli), a widely distributed Palaearctic species of which I obtained specimens in Lake Biwa.

[1] *Proc. Acad. Nat. Sci. Phil.* LX, p. 35, fig. 1 (1908).

Pisidium casertanum (Poli).

(Pl. III, fig. 14.)

1909. *Pisidium* (*Fluminina*) *dubium*, Lindholm in Korotneff's *Wiss. Ergebn. Zool. Exp. Baikal-See*, IV (*Mollusken*), p. 85, pl. ii, figs. 45, 46.

1916. *Pisidium casertanum* form *lacustris*, Preston, *Ann. Mag. Nat. Hist.* (8) XVII, p. 162.

Shells from Lake Biwa are referred by Preston, apparently in consultation with B. B. Woodward, to the "forma *lacustris*," but are said by the latter to be rather more oval than usual. I take it that the "forma *lacustris*" is the phase mentioned by Woodward (*op. cit.*, p. 36) as "a lake or still water form, which almost amounts to a variety." This phase is characterized as being rounder than the type and more compressed and having the hinge, which is narrower and lighter, less arcuate and with a less pronounced flexure.

Of all the numerous phases and races of *P. casertanum* described by various authors and not regarded by Woodward as even on a level with his "lake or still water form," shells from L. Biwa resemble most closely those from shallow water (one fath.) in L. Baikal to which Lindholm gave the name *P. dubium*. They differ only in being a little smaller and a trifle more compressed, and probably in greater fragility and translucency—all characters commonly associated with life in deep water.

The following tables illustrate the resemblances and differences so far as measurements (given in millemetres) and proportions can.

	Deep-water Biwa Phase.	*Shallow-water Baikal Phase* (dubium).
Length	4·8. 3·6. 3·9. 3·9. 4·0. 4·04.	6·0. 5·9. 5·0.
Height	3·2. 3·1. 3·0. 3·2. 3·3. 3·2.	4·8. 4·8. 4·0.
Thickness	2·06. 1·9. 1·8. 1·9. 2·0. 2·06.	3·2. 3·1. 2·7.
Height to length (average)	1 : 21	1 : 24.
Thickness to height	1 : 1·64	1 : 1·51.
Thickness to length	1 : 2	1 : 1·88.

Two other "species" from L. Baikal (*P. maculatum* and *P. trigonoides*, Dybowski) [1] are considered by Woodward as synonymous with *P. casertanum*. They were both found in 20-60 fathoms and differ notably from *P. dubium* in their prominent umbones, a feature noted by Clessin[2] in deep-water forms of the genus from Swiss lakes but conspicuously absent from the deep-water Japanese specimens. Though Dybowski and Kobelt place these two Siberian forms in different subgenera (*P. maculatum* in *Fluminina* and *P. trigonoides* in *Fossarina*) it is by no means certain that they are more than growth-stages of a single form.

P. casertanum is very abundant in L. Biwa at depths greater than about 17 fathoms. It usually occurs on a bare muddy bottom and is found with *Valvata biwaensis* and *V. annandalei*. L. Baikal is the only other Asiatic locality from which any phase of the species has yet been recorded, but it is wide-spread in Europe.

[1] See Kobelt in the new edition of Rossmassler's *Icon. Land-und Süsswasser Moll.* X, pp. 32, 33, pl. cclxxix, fig. 1807; pl. cclxxxi, fig. 1809 (1903).

[2] *Bull. Soc. Vaudoise Nat. Sci.* XIV, p. 240, pl. iii (1877).

Part II. GEOGRAPHICAL DISTRIBUTION.

The majority of the molluscan genera found in Lake Biwa fall into one of three geographical categories—either they are practically cosmopolitan in distribution, or they have a wide range in the warmer regions of the world, or else they are found on the mainland and islands of eastern Asia.

To the first of these categories belong *Limnaea*, *Planorbis*, *Bithynia*, *Vivipara*, *Sphaerium* and *Pisidium*. The tropical and subtropical genera not restricted in range geographically include only *Melania* and *Corbicula*; while *Hyriopsis*, *Cristaria*, *Plectholophus*, *Lanceolaria*, *Nodularia* and *Pseudodon* are characteristically eastern Asiatic.

Anodonta and *Valvata* are essentially Palaearctic genera, though species of the former occur in tropical Asia. The range of *Lithotis* and *Choanomphalus* is evidently as yet but imperfectly known. The former has been recorded only from Peninsular India and from Lake Biwa; while the latter, best known from Lake Baikal, occurs also in the eastern Mediterranean region and possibly on the Pacific side of North and South America.

Of the cosmopolitan genera it is unnecessary to say more at present: of the two tropical and subtropical genera it may be noted that in both cases the range extends rather further north in eastern Asia than it does in the West. The eastern Asiatic genera seem to represent two elements, one certainly southern and the other possibly northern in origin. The double immigration will become clearer if we consider with these mainland types the Palaearctic genera *Valvata* and *Anodonta*, and also *Pisidium*, the range of which is somewhat anomalous so far as Japan is concerned. *Anodonta*, it is true, does not provide strong evidence, for some species are widely distributed over the warmer parts of the Far East. *Cristaria*, however, appears to be mainly northern; *Hyriopsis*, *Lanceolaria*, *Pseudodon* and possibly *Nodularia* mainly southern. *Valvata* is only known in Japan at present from two deep lakes in the Main Island; its species are found in Europe, Northern Asia and North America, and it is probable that no true representative occurs in the tropics. *Pisidium*, though several species are found in tropical Asia, is only known as yet, so far as the Japanese islands are concerned, from the almost sub-Arctic Hokkaido and from Lake Biwa. It is possible that the small size of the shell has caused it to escape notice in other localities, but the abundance of *P. casertanum* in the deeper parts of Lake Biwa, though it does not entirely preclude this point of view, is nevertheless opposed to it.

The status of Lake Biwa as the meeting place of two lines of migration from the north and from the south respectively will become still clearer when we discuss the distribution of species as distinct from that of genera.

It is convenient to consider the species under three headings, to include (1) those that are apparently endemic in the basin of the lake, (2) those that are endemic in the islands of Japan, and (3) those that are found also on the mainland of Asia. They may therefore be listed as "Endemic," "Japanese" and "Mainland." Omitting for the present varieties and local races (subspecies), 33 species of aquatic Mollusca are known to occur in the lake and its immediate surroundings. As will be seen from the three lists that follow, 11 of these are known only from the basin of Lake Biwa, and 15 from Japan; while 7 have been found also in eastern continental Asia.

Endemic.	Japanese.	Mainland.
Lithotis japonica.	*Limnaea japonica.*	*Limnaea pervia.*
Choanomphalus japonicus.	*Melania libertina.*	*Bithynia striatula.*
Planorbis (Gyraulus) biwaensis.	*Vivipara japonica.*	*Cristaria plicata.*
Melania multigranosa.	*Vivipara malleata*	*Anodonta woodiana.*
Melania niponica.	*Vivipara sclateri.*	*Lanceolaria bilirata.*
Melania biwae.	*Hyriopsis schlegeli.*	*Corbicula sandai.*
Valvata biwaensis.	*Cristaria spatiosa.*	*Pisidium casertanum.*
Valvata annandalei.	*Pletholophus reiniana.*	
Nodularia biwae.	*Anodonta calipygos.*	
Nodularia reiniana.	*Lanceolaria oxyrhyncha.*	
Corbicula viola.	*Nodularia japanensis.*	
	Nodularia hirasei.	
	Nodularia parcedentata.	
	Pseudodon loomisi.	
	Sphaerium heterodon.	

Of the species apparently endemic in the lake two hold a peculiar position on account of the genera to which they belong, *viz.*, *Lithotis japonica* and *Choanomphalus japonicus.* The shells are, however, in both cases very small and inconspicuous and the animals live concealed on the lower surface of stones, a position in which they may very well have escaped notice in other localities. This is also true of *Planorbis* (*Gyraulus*) *biwaensis*. *Valvata biwaensis* and *V. annandalei* are only found in deeper water than has been investigated in any other Japanese lake. The only other Japanese species of *Valvata* as yet known (*V. japonica*, v. Martens) was described from a single specimen taken, presumably near the margin, in a still deeper lake, that of Hakoné, and the type had probably strayed from deep water. Relatives of these species are all from northern latitudes.

The remaining six species endemic in Lake Biwa are all fairly large and conspicuous forms and, with the possible exception of *Melania biwae*, are abundant at suitable spots in the lake. The three species of *Melania* are closely related and seem to represent a strictly localized group. Pilsbry[1] has pointed out that a form closely resembling *M. multigranosa* superficially (*M. reiniana* var. *hidachiensis*, Pilsbry) has probably been derived from another section of the genus by parallel evolution in another part of the Main Island of Japan.

Nodularia biwae and *Corbicula viola* are fairly distinct species, but *N. reiniana* is closely related to an otherwise isolated form (*N. hirasei*, Haas) the type of which was found in the same part of Japan but not in a lake. Haas expressed the opinion that *N. reiniana* was possibly no more than a lacustrine phase of *N. hirasei*, but the two occur in Lake Biwa and there is no very definite evidence at present that they affect different types of environment.

[1] *Proc. Acad. Nat. Sci. Phil.* LIV, p. 119, pl. ix, fig. 2 (1902).

It is thus clear that there is a distinct endemic element among the Mollusca of Lake Biwa. The apparent strangeness given to this element by the occurrence of two such unexpected genera as *Lithotis* and *Choanomphalus* is probably more apparent than real, but it is worthy of notice, in reference to the former, that another peculiar genus hitherto regarded as exclusively Indian (*Camptoceras*[1]) has also been found quite recently in Japan. If the anatomy of the Indian and Japanese forms should prove to be similar, the probability is, in both cases, that other species will be found sooner or later in many other parts of eastern Asia.

The true Japanese molluscs found in Lake Biwa and its immediate vicinity are not in themselves by any means remarkable, but the distribution in Japan of the different forms is interesting in that it is by no means identical. Unfortunately the range of the Japanese fresh-water Mollusca has as yet been studied in most cases but incompletely. *Nodularia hirasei*, as has already been noted, is known only from the central part of the Main Island; *Limnaea japonica* occurs on the islands of Hokkaido and Shikoku, while *Melania libertina* and *Vivipara malleata* are distributed over the greater part of the Japanese Empire, in the one case from Hokkaido, and in the other from the north of the Main Island, to Formosa.

It is worth while to consider the distribution of the seven species found on the mainland of Asia in some detail, species by species.

The distribution of *Limnaea pervia* is incompletely known. It was described from China and has been recorded from Tokyo on the Pacific coast of the Main Island of Japan

Bithynia striatula appears to be mainly a southern species. It has been recorded from Cambodia and from several localities in central China. The Japanese race (var. *japonica*, Pilsbry) varies considerably in the very character that distinguishes it from the *forma typica*, *viz.*, in the development of the spiral ridges; it is only known from the Main Island.

Cristaria plicata is a very variable species, evidently sensitive to differences of environment; it has been found in many localities on the mainland of north-eastern Asia including some as far north as the Amur, and also in Cambodia.[2]

Anodonta woodiana has on the whole a somewhat more southerly distribution, though it has been reported doubtfully from the Amur region; in a south-westerly direction its range extends as far as Siam.

Lanceolaria bilirata seems to be a scarce form. It is only known from Cochin-China and Japan and is closely related to the endemic Japanese *L. oxyrhyncha*. It must be regarded as an essentially southern form, but its precise distribution in Japan is unknown and it has probably been confused with *L. oxyrhyncha*.

Corbicula sandai has a somewhat similar range, but there is definite evidence that it does not occur north of Lake Biwa, in which it is not at all common.

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1 Preston, *Ann. Mag. Nat. Hist.* (8) XVII, p. 160 (1916). My specimens, which apparently belong to an undescribed species, were obtained for me through the kind offices of Mr. Hirasé by Mr. S. Tetsuaki Kira, who informed me that the species was by no means uncommon at Kogamura in the Osaka district. I kept them alive for some weeks; they were entirely aquatic in habits, remaining among water-weeds in an aquarium.

2 Preston, *Rec. Ind. Mus.* VII, p. 280 (1912)

Pisidium casertanum is a very widely distributed Palaearctic species, extremely variable and therefore burdened with a vast synonomy. On the mainland of Asia it has only been found as yet in Lake Baikal. It may be regarded as distinctly northern in origin.

Thus, if we consider these seven mainland species together with those that are endemic either in the basin of Lake Biwa or in Japan as a whole, we find strong evidence of the two lines of migration to which I have already referred more than once. *Lanceolaria bilirata*, *Corbicula sandai* and possibly *Lithotis japonica* and *Bithynia striatula* are southern forms, while *Pisidium casertanum*, the two species of *Valvata*—it should be noted that these three are deep-water molluscs in Lake Biwa—and possibly *Hyriopsis schlegeli* and *Choanomphalus* represent an immigration from the north.

Part III. BIOLOGICAL DISTRIBUTION.

In this section of my paper I propose to consider the distribution of the molluscan fauna of Lake Biwa into various life-zones. Before doing so, however, it will be necessary to give a few particulars as to the physical characters of the lake (see map on next page). For these particulars I am indebted largely to a little guide-book in English published by the authorities of the Shiga Prefecture. The geographical statements in the book are, I believe, founded largely on the investigations of the officers of the Prefectural meteorological and fishery stations at Hikoné, to whom I was also indebted for valuable verbal information. Much of this information is otherwise available only in Japanese.

Physical characters of Lake Biwa.

Lake Biwa has a superficial area of 269 square miles and a circumference of 144 miles. It is divided into two regions,— a southern region in which the water is shallow and choked with weeds, and a much larger northern region, the greater part of which has a depth of over 200 feet. In this latter region there are two deep depressions of considerable area in which depths of over 250 feet are recorded; at the deepest point the depth is 320 Japanese feet (=97 metres). In the map on p. 58 the depths are shown in Japanese feet, according to the investigations of the Shiga meteorological and fishery bureaus.

The bottom is for the most part muddy, especially near the centre of the lake, but at certain places there are beaches of coarse sand, which extend out into the water for a considerable distance from the shore. In the northern region there are one or two small rocky islands and at several places, notably near Otsu at the south end of the lake, the margin is covered with small stones and broken pottery, derived mainly from old buildings and the like.

The 136th parallel of eastern longitude runs through the lake, while the 35th of northern latitude passes a few miles to the south.

The water of Lake Biwa is remarkably clear and free from sedimet. The mean summer temperature near the shore is 33°C. and out in the middle 30°C. In the greatest depths the temperature falls as low as 8°C. at that season. In winter the average temperature is 8°C. It has been calculated that 33 % of the waters of the

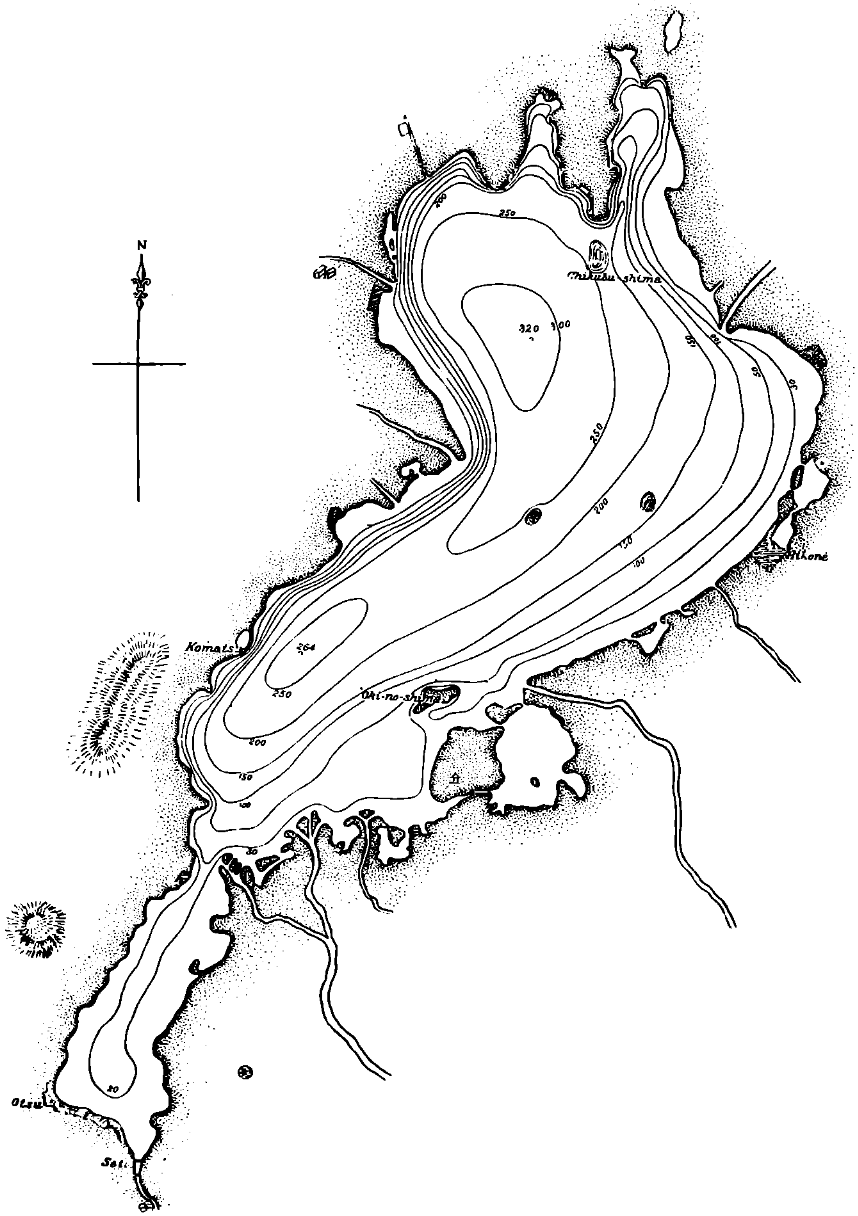

FIG. 1.—Map of Lake Biwa, showing depths in feet. Scale, *ca*. 5 miles to the inch. (After maps issued by the Meteorological and Fishery Bureaus of the Shiga Prefecture).

lake have a summer temperature of over 20°C. On October 1st we found that the temperature of mud brought from 260 feet was 8°C., while that of the air was 22°C.

It is thus manifest that the temperature of Lake Biwa varies greatly, as might be expected, with depth as well as with the seasons.

Zones of life in the lake.

In a general survey of the Mollusca of Lake Biwa based on field knowledge two facts stand out prominent—firstly that the species which live among stones and rocks are different from those commonly found on a muddy or sandy bottom, and secondly that certain species only occur in deep water. A more careful scrutiny reveals a third fact—that a few species, though they can hardly be excluded from the lake-fauna, are not really lacustrine but frequent pools, ditches, etc. at the edge of the lake. Except in the case of the rupicolous forms, the lines are not drawn exactly; shallow-water forms stray occasionally into deep water and individuals of non-lacustrine species are sometimes found in the lake. Nevertheless, the facts stated form a convenient basis for a biological classification of the fauna. At present this classification can be applied to the Mollusca only, but I have the strongest evidence that it will also be found applicable to the lake-fauna as a whole, when it has been completely worked out from a systematic point of view.

The lists below are formed by classifying the Mollusca in accordance with this scheme, under the headings "Rupicolous," "Shallow-Water," "Deep-Water" and "Non-lacustrine." Among Rupicolous species are included those that adhere to small stones.

Rupicolous.	**Shallow-Water.**	**Deep-Water.**	**Non-lacustrine.**
LITHOTIS JAPONICA.	MELANIA MULTIGRANOSA.	*Melania multigranosa.*	LIMNAEA JAPONICA.
CHOANOMPHALUS JAPONICUS.	VIVIPARA SCLATERI.	*Vivipara sclateri.*	*Melania libertina* (typical form).
PLANORBIS BIWAENSIS	*Hyriopsis schlegeli.*	VALVATA BIWAENSIS.	VIVIPARA JAPONICA.
Melania libertina (dwarfed).	*Cristaria plicata.*	VALVATA ANNANDALEI.	VIVIPARA MALLEATA.
MELANIA NIPONICA.	*Cristaria spatiosa.*	*Cristaria plicata.*	SPHAERIUM HETERODON.
MELANIA BIWAE.	*Pletholophus reiniana.*	CORBICULA VIOLA (dwarfed).	
Bithynia striatula japonica.	*Anodonta woodiana.*	PISIDIUM CASERTANUM.	
	Anodonta calipygos.		
	LANCEOLARIA BILIRATA.		
	LANCEOLARIA OXYRHYNCHA.		
	NODULARIA JAPANENSIS.		
	NODULARIA BIWAE.		
	NODULARIA REINIANA.		
	NODULARIA HIRASEI.		
	? *Nodularia parcedentata.*		
	? *Pseudodon loomisi.*		
	Corbicula sandai.		
	CORBICULA VIOLA.		

In these lists the names of the species particularly characteristic of the different zones are printed in Roman capitals.

Limits of "Deep" and "Shallow" water.

In European lakes the 100-metre line has been accepted by limnologists as a convenient but conventional boundary between the shallow-water and the deep-water fauna, just as marine zoologists accepted the 100-fathom line. In Lake Biwa no spot is deeper than 320 feet[1] (about 97 metres) and no considerable area much deeper than 75 metres, but in practice, though the boundary is not exact, we find that the upper bathymetric limits of the deep-water fauna lie somewhere very near 100 feet (= a little over 310 metres).

RUPICOLOUS FORMS.

Species from the lower surface of small stones.

The shores of Lake Biwa are for the most part flat and either sandy or muddy, but towards the northern end of the lake, especially on islands such as Chikubushima, there are rocks that descend abruptly into the water to a depth of at least 20 feet, while both at the same localities and at the south end, the bottom at certain spots is covered close inshore with small stones. In most cases the small stones are of artificial origin, but they seem to have encouraged the assemblage of a somewhat characteristic fauna, consisting, so far as the molluscs are concerned, of small species of gastropods that find a secure hiding place on their lower surface.

Lithotis japonica, *Choanomphalus japonicus* (with its variety *substriatulus*) and *Planorbis biwaensis* are characteristic species of this fauna.

True rupicolous species.

Melania niponica and *M. biwae* do not seek concealment in the same way, but crawl openly on vertical as well as horizontal surfaces and appear to attain their maximum development only on large rocks. The shells of *M. niponica* found on stones at Otsu are small and much eroded, not exceeding 20 mm. in length and 9·5 mm. in maximum breadth, and their sculpturing is comparatively ill-developed. Shells of the same species found on small stones at Chikubushima are less eroded, but only a little larger and in other respects similar; it is only on the rocky shores of the island and a few similar spots in the northern part of the lake that large and well-developed shells are to be obtained (compare figs. 3A and 3B, pl. III). Such shells often reach a length of 32 mm. and a maximum breadth of 14 mm. Looking down through the clear water from a boat one sees enormous numbers of fine examples covering the rocks to a considerable depth. It was only on the rocks at Chikubushima that I obtained specimens of *M. biwae*.

No Lamellibranchiata have been found on rocks or stones in the lake.

Doubtful species.

Melania libertina and *Bithynia striatula japonica* are not in quite the same biological category as the species discussed above. They are found, the latter in very small numbers only, on stones at the edge near Otsu. The specimens of *M. libertina* are pale in colour and have distinct

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[1] The difference is so slight (less than 1 metre in 50) that it does not matter whether we use English or Japanese feet. One Japanese foot (*shaku*) equals 11·9305 inches.

reddish bands as in the type of *M. retifera*, Tryon. They were smaller than speci-

Page 60, line 8. *For* 310 *read* 31.

Hikoné (ditch)	.. ..	20 mm.	12 mm.	Tip slightly eroded.
Sakamoto (ditch)	.. ..	30 mm.	12·5 mm.	Tip eroded.

It is probable, therefore, that *M. libertina* is not, strictly speaking, a lacustrine species, for it does not attain its full development in the lake.

The typical form of *Bithynia striatula* appears to be, at any rate in central China, a true lacustrine form; it is common in the Tai-Hu of the Kiangsu Province on stones near the margin. I am doubtful, however, whether the Japanese race has the same habits. It has been found at places where there are no large lakes, and my own specimens from Lake Biwa were taken in a kind of backwater. It is very probable, therefore, that it should be included among the non-lacustrine forms found close to Lake Biwa and occasionally straying into the lake.

There is no evidence that the restricted bathymetric range of the rupicolous species of Lake Biwa is due in any way to depth of water, for the peculiar environment that suits them happens to occur there at the margin or around islands, and any rocks that may have existed in the deeper depressions have long ago been buried in mud.

Except where the shore is stony or rocky there are extremely few molluscs to be found in the water less than about 10 feet deep. This may be due, partly at any rate, to the careful habits of Japanese fishermen, who do not permit even small animals that they consider edible to escape their notice.

SHALLOW WATER FORMS.

The nature of the bottom of Lake Biwa, even in comparatively shallow water, differs considerably, as I have already indicated, in different parts of the lake. The southern region is for the most part muddy and produces so dense a growth of weeds that they are raked into large boats and spread out as manure on the fields. Towards Seta in the south-east corner, however, considerable quantities of sand are mixed with the mud and the weeds are much less luxuriant. The eastern side of the lake is muddy, while beaches of very coarse sand extend along a great part of the western shore and outwards into water over 100 feet deep.

Less variation in the Molluscan fauna is correlated with this variation in environment than might be expected. *Limnaea pervia*, a scarce species, has only been found among weeds and *Corbicula sandai* on a bottom of muddy sand, on which *C. viola* is reddish bands as in the type of *M. retifera*, Tryon. They were smaller than specimens from the hills on the western side of the lake and from ditches at Hikoné. The shells from Hikoné were much darker. The following are the measurements of large examples from the lake at Zézé, from a ditch at Sakamoto and from a ditch at Hikoné respectively.

MELANIA LIBERTINA.

	Length.	*Maximum breadth.*	*Condition.*
Zézé (Lake Biwa)	19 mm.	8 mm.	Tip eroded.
Hikoné (ditch)	20 mm.	12 mm.	Tip slightly eroded.
Sakamoto (ditch)	30 mm.	12·5 mm.	Tip eroded.

It is probable, therefore, that *M. libertina* is not, strictly speaking, a lacustrine species, for it does not attain its full development in the lake.

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Less variation in the Molluscan fauna is correlated with this variation in environment than might be expected. *Limnaea pervia*, a scarce species, has only been found among weeds and *Corbicula sandai* on a bottom of muddy sand, on which *C. viola* is much more abundant than elsewhere[1]; but, speaking generally, the two common Gastropod species (*Vivipara sclateri* and *Melania multigranosa*) are equally abundant whether the bottom be muddy, sandy, or of a mixed nature, whether weeds be present or absent, at all points between 10 and 100 feet deep.

Unionidae of Lake Biwa.

My knowledge of the distribution in the lake of the different species of Unionidae is less exact, for it is difficult in some cases to distinguish the different species and while in Japan I did not fully understand the specific or even the generic differences. It is, moreover, almost impossible to obtain specimens of molluscs that lie buried in mud at the base of a luxuriant growth of water-weeds. It will be well, therefore, to give here a statement as to the actual depths at which the different genera of Lamellibranchiata were dredged by Dr. Kawamura and myself in a living state.

Depths at which the Genera of Lamellibranchiata were dredged in Lake Biwa.

Cristaria	2-3 fathoms ; 41 fathoms.
Anodonta	1½-7 fathoms ; 2-3 fathoms ; 6-7 fathoms ; 5-17 fathoms.
Lanceolaria	2-3 fathoms ; 3½ fathoms : 5-17 fathoms.
Nodularia	1½-7 fathoms ; 2-3 fathoms ; 3½ fathoms ; 6 fathoms ; 5-17 fathoms.
Corbicula	2-3 fathoms ; 3½ fathoms ; 6 fathoms ; 6-7 fathoms ; 5-17 fathoms, 9½-17 fathoms ; 17 fathoms ; 41 fathoms.
Pisidium	9½-17 fathoms ; 31-33 fathoms ; 34 fathoms ; 41 fathoms ; 43 fathoms ; 53 fathoms.

In several instances these figures are a little unsatisfactory owing to the sudden slope of the bottom near the shore. This makes it impossible, without apparatus I did not possess, to fix the exact depth at which a specimen was actually taken into the net. It may be stated that all the stations at which depths above and below 100 feet were recorded in the course of a single haul of the net were close inshore, while all those at which the greatest depth recorded exceeded 100 feet were in the middle of the lake. The bottom is always sandy where it descends abruptly. I did not take, or at any rate bring away, specimens of *Hyriopsis* or *Pseudodon*, but the former genus is represented in the late Dr. John Anderson's collection from Lake Biwa by a fine series of shells of *H. schlegeli*.

Lamellibranchiata of shallow water.

If my figures in reference to the six genera of Lamellibranchiata be analysed, it becomes quite clear that from a bathymetric point of view *Pisidium* falls into a different category from the others and cannot be dealt with under the heading "Shallow-water Forms," while *Cristaria* must be considered both as a shallow-water and a deep-water genus. This is not due to a difference in the habits of different species, for young specimens of *C. plicata* were taken in small numbers from both the depths recorded. My figures also provide definite evidence that the bathymetric range of *Corbicula*

[1] One of the most important fisheries for this species is situated near Seta, the Corbiculae of which enjoy great reputation among Japanese epicures.

extends in Lake Biwa from between 2 and 3 to 41 fathoms. As will be shown later, shells from the greatest depth are dwarfed and the genus is not common at most places below 100 feet. I obtained no evidence that *Anodonta*, *Lanceolaria*, and *Nodularia* went deeper than about 6 fathoms.

These results, imperfect as they are, may be compared with those obtained by the Japanese fishery experts, with which, in most respects, they are in general agreement. In the map published in the pamphlet to which I have alluded at the beginning of this paper, *Corbicula* is not shown as occurring at depths much greater than 30 fathoms. But the map was prepared largely from a commercial point of view, and from the fact that the authors were apparently unacquainted with the existence of *Pisidium* and *Valvata* in the lake it would seem that they did not explore the greater depths. They show *Cristaria* as descending to about 30 fathoms, while *Nodularia* and *Lanceolaria*, which they did not distinguish one from the other, are represented as most abundant between 6 and 10 fathoms. *Hyriopsis* is recorded by them from comparatively few localities on the east side of the lake, between 6 and 10 fathoms and in quite shallow water. There is no evidence available as to the bathymetric range of *Pseudodon* in the lake. The single species that occurs (*P. loomisi*) is probably scarce.

Taking the Japanese records, which are based on long-continued local investigations, into consideration with my own results, the following facts become evident as to the shallow-water species, *i.e.*, those found in depths less than 100 feet.

The majority of the Mollusca found in Lake Biwa occur between 2 and 17 fathoms. From this zone no less than 16 species and 9 genera have been definitely recorded. The majority of the species (11) belong to the family Unionidae, of which no less than 6 genera are included. With the exception of *Cristaria plicata*, all the species of this family are apparently true shallow-water forms not occurring below 100 feet.

Although the Unionidae thus predominate so far as number of species is concerned, it is probable that the majority of individual molluscs present in the lake belong to the three species *Melania multigranosa*, *Vivipara sclateri* and *Corbicula viola*. None of these species are strictly confined to water shallower than 100 feet. Their precise bathymetric range will, therefore, be considered with that of the deep-water forms. *Corbicula sandai* has been taken only in shallow water, but it is apparently very scarce in Lake Biwa. The precise distribution of the different species of Unionidae must be left for local observers to elucidate.

Predominant species.

DEEP-WATER FORMS.

In some respects the deep-water fauna of Lake Biwa is more interesting than that of any other zone, for few particulars are available in reference to deep-water forms from other lakes in Asia. I may say now, that when the complete results of my investigations in the Japanese lake are published they will prove that the Mollusca are by no means the only groups in which distinct deep-water forms occur, for this is also the case with the Turbellaria,[1] the Hirudinea, the Amphipoda, the Isopoda and possibly the Oligochaeta.

On the opposite page particulars are given of my collecting stations in the lake at which Mollusca were obtained from depths greater than 100 feet.

Of the seven species dredged at these deep-water stations, three (*Vivipara sclateri*, *Melania multigranosa* and *Corbicula viola*) are abundant in shallow water. The two

Species found in both shallow and deep water.

Gastropods become gradually scarcer as depths over 100 feet are reached, but occur occasionally even at depths of over 250 feet. They make their way most readily into deep water from the abruptly shelving sandy beaches on the western side of the lake. Shells of these species from deep water are not at all dwarfed; indeed two specimens of *M. multigranosa* from 36 fathoms, though much eroded, were the stoutest examples taken on my tour.

Shells of *Corbicula viola* from between 100 and 200 feet do not differ materially from those that live between 10 and 100 feet, though perhaps they never attain quite so large a size. Specimens, however, from 260 ft. (Sta. 8) were not only very small but also more symmetrical and more inflated than normal shells (pl. III, fig. 11). I have given my reasons on p. 52 for regarding these shells as dwarfed and not merely young.

Cristaria plicata is not nearly so abundant a species as *V. sclateri*, *M. multigranosa* and *Corbicula viola*, but resembles them in being able to live over a wide bathymetric range. Only a few young individuals were taken in deep water (250 feet).

The true deep-water Mollusca of Lake Biwa are thus reduced to three species, *Valvata biwaensis*, *V. annandalei* and *Pisidium casertanum*. No one of these species probably occurs at depths less or much less than 100 feet = a little over 30 metres = nearly 17 fathoms. From about this point their bathymetric range extends to 320 feet = 97 metres = a little over 53 fathoms, the greatest depth of the lake. They are common at all intermediate depths, but *V. annandalei* is as a rule less abundant than the other two. In their small size, in the thinness of the shells and in the pale colour of both shells and soft parts they are characteristic deep-water forms.

The two species of *Valvata* are closely related to one another and are apparently identical in habits. In the shape of the shell *V. annandalei* is not unlike the common

Japanese species of Valvata.

European *V. piscinalis* (O. F. Müller), which according to Thiele[2] lives in shallow, still or slow-running water on a muddy bottom. The closest ally of the two Biwa species is probably, however, *V.* (*Cincinna*) *korotneyi*, Lindholm,[3] which was found by Korotneff in Lake Baikal on mud among weeds in only one fathom of water. This species seems to resemble *V. annandalei* in sculpturing and *V. biwaensis* in shell-form, but is larger and darker than either. Neither species from the Japanese lake is related to those found in deep water either in Lake Baikal or in Europe. The only other representative of the genus as yet known from Japan was described from a single specimen from Hakoné Lake,

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[1] See Ijima and Kaburaki, *Annot. Zool. Japon.* IX, p. 157 (1916).

[2] Thiele in Brauer's *Susswasserfauna Deutsch.* XIX (*Mollusca*), p. 29. fig. 66 (1909).

[3] Korotneff's *Wiss. Ergebn. Zool. Exp. Baikal-See* IV (*Mollusken*), p. 73, pl. i, figs. 63-65 (1909).

Station No.	Date.	Position.	Depth.	Bottom.	Mollusca.
Sta. 15.	2-x-15.	Close in shore, W. Coast of Oura Bay.	58—104 feet.	Sand with shells, passing gradually into fine mud. Weeds between 70 and 80 feet.	*Vivipara sclateri*, *Melania multigranosa*, *Valvata annandalei*, *Corbicula viola*, *Pisidium casertanum* (all abundant).
Sta. 4.	1-x-15.	Off Komatsu.	104 feet.	Fine sand and gravel.	*Melania libertina*, *Vivipara sclateri*, *Nodularia* and *Lanceolaria* spp., *Anodonta calipygos*, *Corbicula viola* (all abundant). *Corbicula* normal.
Sta. 6.	1-x-15.	Off Komatsu.	180 feet.	Mud mixed with fine pebbles.	*Valvata biwaensis* and *V. annandalei* (both abundant).
Sta. 12.	2-x-15.	$\frac{2}{3}$ distance between m. of Aine R. and Chikubushima.	190—200 feet.	Fine grey mud.	*Valvata biwaensis*, *V. annandalei* and *Pisidium casertanum* (all common).
Sta. 14.	2-x-15.	Off Suga, N. W. of Chikubushima.	204 feet.	Fine grey mud with cinders from steamer.	*Melania multigranosa* (2); *Valvata biwaensis* and *V. annandalei* (both common); *Pisidium casertanum* (a few).
Sta. 5.	1-x-15.	Off Komatsu.	250 feet.	Fine mud.	*Hyriopsis schlegeli* (2 juv.); *Pisidium casertanum* (1).
Sta. 8.	1-x-15.	$\frac{1}{2}$ mile S. W. of White Rocks (middle of lake).	260 feet.	Mud with fragments of shell.	*Vivipara sclateri*, *Melania multigranosa*, *Valvata biwaensis* and *V. annandalei* (all fairly abundant); *Corbicula viola* (few damaged).
Sta. 17.	3-x-15.	Deepest pocket S. E. of Chikubushima.	520 feet.	Fine mud.	*Valvata annandalei*, *V. biwaensis*, *Pisidium casertanum* (all common).

which is even deeper than Lake Biwa. No particulars are available as to the depth at which it lives, but even if it were taken at the edge, as is most probable, it may have strayed from deep water; it appears to have been captured alive. In Lake Biwa I found a single dead shell of *Valvata biwaensis* embedded in a sponge growing within a few yards off the shore. *V. japonica* is stated by von Martens[1] (who described it in 1877) to be intermediate between the European *V. naticina* and the North American *V. sincera*; it is probably related closely to the Biwa forms.

The Japanese representatives of this genus may thus be regarded as forms of northern origin. A few species of *Valvata* may possibly make their way into the tropical parts of Asia, but the only form recorded (with a query as to the genus) from India south of the Himalayas (*Valvata? microscopica*, Nevill)[2] belongs to the marine family Cyclostrematidae.[3] The genus, indeed, is perhaps exclusively Holarctic.

The *Pisidium* found in deep water in Lake Biwa belongs, as is stated above, to the Palaearctic species *P. casertanum* (Poli). Both shallow-water and comparatively deep-water forms from Lake Baikal are relegated to the synonomy of *P. casertanum* by Woodward, namely *P. maculatum* and *P. trigonoides*, Dybowski[4] (from 20 to 60 metres) and *P. dubium*, Lindholm[5] (from 6 to 8 metres). To judge from the published figures of these forms, Biwa shells resemble *P. dubium* very closely in lateral outline, but are a little smaller and slightly more compressed; they are more elongate and have the umbones less prominent than either of Dybowski's "species," which, though he places them in different subgenera, are perhaps mere growth-stages of a single phase.

European specimens of *P. casertanum* are usually larger than my Japanese shells, but, even in the lacustrine phase, exhibit great variation both in size and shape.

Deep-water forms of Pisidium.

Among the 23 nominal species of *Pisidium* listed by Zschokke[6] as occurring in the lakes of central Europe in water of 30 metres or over, only one (*P. italicum*, Clessin) is included in the synonomy of *P. casertanum* by Woodward, who regards most of the deep-water forms of the genus as of doubtful status but suggests that many are probably forms of *P. pusillum* (Gmelin). Moreover, it is doubtful whether the *P. italicum* from deep water (Lago Maggiore in northern Italy; 80 m.) is absolutely identical with the shallow-water form to which that name has been applied. Zschokke, following Clessin and Forel, classifies two of the twenty-three deep-water species as "Abkommlinge von *Pisidium italicum*" (namely *P. luganense* and *P. locarnense*), and six as allied to *P. fossarinum*, which according to Woodward is synonymous at any rate in part with *P. casertanum*. It would be a mere waste of time to attempt to discuss the minute and often inconstant differences between all these forms. Indeed, it is sufficient for the present to say that Japanese deep-water shells of *P. casertanum* agree in their small size and elong-

[1] von Martens, *Sb. Ges. nat. Freunde*, p. 116 (1877).

[2] Nevill, *Hand List Moll. Ind. Mus.* II, p. 17 (1884).

[3] Annandale and Kemp, *Mem. Ind. Mus.* V, p. 347, fig. 3 (1916).

[4] See Kobelt in Rossmassler's *Icon. Land-und Süsswasser-Moll.* (new ed.) X, pp. 32, 33, pl. cclxxix, fig. 1807; pl. cclxxxi, fig. 1809 (1903).

[5] In Korotneff's *Wiss. Ergebn. Zool. Exp. Baikal-See* IV (*Mollusken*), p. 83, pl. ii, figs. 45, 46 (1909).

[6] Zschokke, *Die Tiefsee Fauna d. See Mitteleuropas*, p. 157 (Leipzig, 1911).

ate form with those of allied types from deep water in Europe, of which Zschokke (*op. cit.*, p. 162) writes as follows:—

> "Die Tiefenpisidien erscheinen somit als kleine, schwache, unscheinbare Kummerformen. Mit innen stimmen im allgemeinen Habitus, besonders in der geringen Grobe, der Zerbrechlichkeit der Schale und in der relativ zur Lange sich dehnenden Korperbreite die Gastropoden der profunden Region uberein."

There is one point, however, in which the *Pisidium* of Lake Biwa differs from its Swiss deep-water congeners [1], namely in its comparatively small umbones. Forms from 20 to 60 metres in Lake Baikal agree with the Swiss forms in this respect, though some at least of the shallow-water forms resemble the Japanese one.

If these are the characteristics associated with life in deep water in the case of a naturally thin and small-shelled genus such as *Pisidium* it does not follow necessarily that they would be developed also in shells of a more robust type. Indeed, so far as our scanty evidence goes, it seems that in *Corbicula*, of which I obtained (*v.* p. 52 *ante*) a few dwarfed, shortened, inflated and highly-coloured specimens in 260 feet (together with normal or approximately normal shells of *Vivipara* and *Melania*) in Lake Biwa, very different results follow. This is evidently not due to an inability on the part of *Corbicula* to produce thin-shelled and colourless forms, for in the Whangpoo River below Shanghai, at a depth of between 6·5 and 7·5 metres, just such a form as might be expected on the analogy of *Pisidium* in deep water occurs not uncommonly. This is evidently Prime's *Corbicula tenuistriata*, which was described from an unknown locality, but neither his description [2] nor Reeve's figure [3] does full justice to its very un-*Corbicula*-like appearance, with its small, pallid, thin, subtrigonal shell, which to the naked eye possesses the most delicate transverse concentric striae instead of the usual ridges. The species is, nevertheless, a true *Corbicula*, for Dr. Ekendranath Ghosh, who has been kind enough to examine my specimens anatomically, informs me that he can find practically no difference between the soft parts and those of the thick-shelled, highly-coloured *C. largillierti* common in still water in the same part of China.

Peculiarities of *Corbicula tenuistriata.*

The peculiarities of *C. tenuistriata*, though they are similar in many points to those of deep-water forms of *Pisidium*, are clearly not due to life in deep water, but are perhaps correlated with life in very stiff mud lying in a strong current beneath very muddy and therefore opaque water; possibly also with a scanty food-supply. It is hard to say what precise factors in deep-water existence—cold, darkness, lack of food, insufficient oxygen, water-pressure, etc.—exert a direct or indirect influence in producing special characters, and it is evident that different factors may have greater effect in some forms of Mollusca than in others.

The deep-water molluscan fauna of Lake Biwa may now be compared with that of other lakes in Europe and Asia.

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[1] See Clessin, *Bull Soc. Vaudoise Nat. Sci.* XIV, p. 240, pl. iii (1877).
[2] *Proc. Zool. Soc. London* 1860, p. 322.
[3] *Conch. Icon.* XX (*Cyrena*), pl. xv, fig. 80 (1878).

The deep-water fauna of the lakes of Switzerland and the surrounding countries, thanks largely in the first instance to the work of Forel, is well known; it has been discussed recently in great detail by Zschokke in his book *Die Tiefsee Fauna der Seen Mitteleuropas, eine geographisch-faunistische Studie* (Leipzig, 1911), from which the following facts are taken.

Deep-water Mollusca of European lakes.

Twelve "species" of Gastropoda and twenty-three of Lamellibranchiata have been recorded from depths of 20 metres and over, all the gastropods and the majority of the bivalves coming from at least 50 metres. The lakes are deeper than L. Biwa and representatives of both groups occur as deep as or deeper than 260 metres.

The Gastropoda belong, with two exceptions, to genera also found in the Japanese lake. The exceptions are *Pyrgula* and *Neritella*: the common genera are *Limnaea*, *Bithynia*, *Vivipara* and *Valvata*. Most of these are represented in deep water by single species, but there are three deep-water forms of *Limnaea* and five of *Valvata*. How far all these forms are to be regarded as distinct species is very doubtful.

The three forms of *Limnaea* occur between 50 and 260 metres, the single *Vivipara* at 60 metres and the five forms of *Valvata* between 60 and 200 metres; the *Bithynia* is found at 60 metres. Most of the "species" are restricted to deep water.

In Asiatic lakes generally, so far as my experience goes, species of *Limnaea* are rarely true lacustrine forms, though they often occur in abundance in pools, ditches and backwaters; while *Bithynia* is found only at the margin among stones. The absence of these two genera from the deep-water fauna of Lake Biwa depends, therefore, in all probability on factors other than bathymetric. It is noteworthy that the only gastropods that occur in that lake below 40 fathoms are either intrusive forms from shallow water, which are apparently not affected so far as size is concerned, or else belong to *Valvata*, the genus perhaps best represented in the European deep-water lacustrine fauna. Though the deep-water species from the two continents are not closely related, the peculiarities of the shells are the same.

Turning to the Lamellibranchiata of deep water in European lakes, the only genus represented (except for possible stray immigrations of individual Unionidae) is *Pisidium*, of which, as has already been pointed out, no less than 23 so-called species have been recorded from depths between 20 and 300 metres In dealing with *P. casertanum* I have said about these all that need be said.

Of course all the deep-water Mollusca of central Europe have not been found in any one lake, and further investigations in other Japanese lakes, among which Lake Biwa ranks only fifth in point of depth, are necessary before a proper comparison can be made. It can, however, already be claimed that, allowing for differences in the fauna of two regions so remote from one another, the deep-water lacustrine Mollusca of the temperate Far East do not appear to differ materially in general characters from those of the lakes of central Europe, and that at any rate some of the genera represented in deep water in the latter region are also represented at similar depths in Japan. So far as Japan is concerned, there is also evidence that the true deep-water forms are of northern origin, but that even warm-water genera such as *Corbicula* and *Melania* can occasionally survive at considerable depths.

Very few molluscs have been described from depths as great as or greater than 20 metres in Asiatic lakes, but particulars are available in at least two instauces in the Palaearctic part of that continent. These are Lake Baikal in northern Siberia and the Lake of Tiberias in Palestine. Practically no information has been published about the deep-water shells of the lakes of the Oriental Region.

The vast area of Lake Baikal, the cold climate in which it is situated and other geographical factors produce conditions very different to those found in a comparatively small and relatively warm lake such as Lake Biwa, but it is interesting to compare the faunas, because both belong, generally speaking, to the eastern part of the Palaearctic Region. Lindholm's monograph of the Mollusca of Lake Baikal provides abundant material for comparison. In his list of species he includes the names of 89, of which 53 (59·5%) have been recorded from 30 metres or over, but of these only 5 (about 5·6%) appear to be true deep-water forms, occurring only in water over 100 feet deep. In Lake Biwa the corresponding percentages are 21·2% and 9%, non-lacustrine species being included in both cases. The warm-water genera *Corbicula* and *Melania* are not found in the Siberian lake, in which three endemic genera (*Baikalia*, *Benedictia* and *Kobeltocecklea*) occur.

Deep-water fauna of Lake Baikal.

The Baikal deep-water species are:—

Choanomphalus westerlundianus (36 m.)
Baikalia flori (96 m.)
B. subcylindrica (53 m.)
B. tenuicosta (53 m.)
B. wrzesniowskii (50-53 m.)

Thus, only one species belongs to a genus represented in the Biwa fauna. Moreover, the only species of this genus known in the Japanese lake is found in shallow water close to the margin. It is noteworthy, however, that it attaches itself to small stones, which in Lake Biwa are only present near the shore, and that the deep-water Siberian form was also found among stones.

Mollusca of the Lake of Tiberias.

The lake of Tiberias, which lies in latitudes approximately the same as those in which Lake Biwa is situated, but on the other side of Asia, is in some respects more strictly comparable with the Japanese lake than Lake Baikal. It is a comparatively warm lake and lies in hilly country, but whereas Lake Biwa is a little over 300 feet above sea-level, the Lake of Tiberias is more than 600 feet below sea-level. A more important difference lies in the fact that the water of the Lake of Tiberias is distinctly brackish and has a peculiar effect on Molluscan shells that apparently renders it impossible for thin-shelled species to survive. Moreover, the Lake of Tiberias is only about 14 miles long and probably at no point more than about 50 metres deep. Its fauna has been discussed by Theodore Barrois[1] and by myself[2], and so far as the Mollusca are concerned our results are in general agreement.

The total number of nominal species of Mollusca recorded from the lake is 42—20 Gastropods, belonging to 9 genera, and 22 Lamellibranchiata, belonging to 2 genera. The Lamellibranchiata are *Unio* (*s.s.*) and *Corbicula*: the Gastropoda are *Limnaea*, *Physa*, *Melania*, *Melanopsis*, *Pyrgula*, *Bithynia*, *Bithinella*, *Valvata* and *Neritina* (=*Theodoxus*).

The synonomy of the western Asiatic species of *Unio* is in a most chaotic condition and no less than 17 have been recorded from the Lake of Tiberias, but it is very probable that half of the names are mere synonyms. This is also the case to a less extent with *Corbicula*, of which 5 have been recorded from the lake.

No species of Mollusca has been found in the Lake of Tiberias at depths greater than about 40 metres. Species of *Unio* are abundant between 10 and 20 metres, less abundant between 20 and 30 metres and scarce at 40. *Melania tuberculata* has a similar bathymetric range, while the Hydrobiid *Pyrgula barroisi* has only been taken in a living condition in 25 metres. Only dead shells of the last are found in shallow water.

Strictly speaking, therefore, there appears to be no true deep-water Molluscan fauna in the Lake of Tiberias, a fact that may be due to the chemical peculiarities of the water. *Pyrgula barroisi* is the only form not found living at spots shallower than 20 metres.

From these brief statements it is clear that no lacustrine Molluscan fauna of precisely the same nature as that of Lake Biwa has as yet been fully discussed from any part of Asia; information about the deep-water Mollusca of the lakes of Celebes and Yunnan, where the shallow-water species are fairly well known, would be of the greatest possible interest. In Celebes[3] particularly most peculiar forms are known among the latter species in lakes that are very deep in places.

NON-LACUSTRINE FORMS.

I have already given my reasons for classifying certain species of aquatic Mollusca common immediately round Lake Biwa as non-lacustrine and for including *Melania libertina* in this category. It is of course very probable that all or any of these species may stray into the lake in floods or at points where backwaters are formed, but, except *M. libertina*, they do not commonly enter the main body of water. It is impossible that this is also the case with one or more species of thin-shelled Unionidae that I have included among the shallow-water lacustrine forms. *Anodonta*, and possibly also *Pletholophus*, is certainly most abundant at places such as Seta or Komatsu where the lake begins to change into a river or is connected with small pools and backwaters. In ditches at Hikoné only indirectly joined to the lake a species of *Ano-*

[1] *Rév. Biol. Nord France* VI, pp. 224-312 (1894).
[2] *Journ. As. Soc. Bengal* (n.s.), XI, pp. 437-476 (1916).
[3] See P. and F. Sarasin's *Süsswass.-Moll. Celebes* (Wiesbaden: 1898).

donta is very abundant, but I did not bring away specimens and am not sure that it was not artificially introduced to serve as food for fishes at the fishery station

SUMMARY AND CONCLUSIONS.

SUMMARY.

Twenty-nine species of true aquatic Mollusca are known to live in Lake Biwa, while four others are common in ditches and small pools in the immediate vicinity. The lacustrine species include twelve Gastropoda and seventeen Lamellibranchiata; the non-lacustrine species, three of the former group and at least one of the latter.

Of the lacustrine species, eleven (about 38%) are known only from the lake, and eleven others only from Japan; while the remainder (about 24%) occur also on the mainland of Asia.

Eighteen (about 12%) of the lacustrine species are found on a muddy or sandy bottom in water less than 100 feet deep, but at least three of these species also stray into deeper water.

Seven species (about 24%) are only found on stones or rocks near the margin.

Seven species occur on a muddy bottom in water between 100 and 320 feet deep, but only three of these (less than 11% of the lacustrine fauna) are true deep-water forms abundant in depths over 260 feet.

CONCLUSIONS.

Lake Biwa, as might be expected from its geographical position and from what is known of the fauna of Japan generally, seems to be, so far as the Mollusca are concerned, the meeting place of two lines of migration, one from the north, the other from the south. The genera *Choanomphalus*, *Valvata* and *Pisidium* are essentially northern genera, while such species as *Nodularia bilirata* and *Corbicula sandai* are southern forms, not known north of the lake. The rupicolous species, including those that adhere to stones, seem mostly to be endemic, but the peculiar stone-loving forms are small, inconspicuous and of furtive habits and may, therefore, have escaped notice elsewhere.

Three of the other eighteen shallow-water species are also endemic, and two of the three true deep-water species; but there are no endemic genera—unless the rupicolous *Lithotis japonica* should ultimately be proved generically distinct from the Indian species.

The true deep-water forms belong to the genera *Valvata* and *Pisidium* and are of northern origin. They agree with European deep-water species of the same genera in their small size, pale colouration and fragility of shell, but the *Pisidium* differs from its deep-water allies of both Europe and Siberia in having the umbones small and by no means prominent.

The few shells of *Corbicula* taken in water over 250 feet deep were small, but short, inflated and relatively thick, though a species of the genus (*C. tenuistriata*, Prime) that has most of the peculiarities of the deep-water forms of *Pisidium* is found in fairly shallow but very muddy water in the Whangpoo River near Shanghai.

No very exact comparison is yet possible between the deep-water Mollusca of Japanese lakes and those of the lakes of Europe and of the mainland of Asia, but, in Lake Biwa at any rate, deep-water forms of the two genera (*Valvata* and *Pisidium*) perhaps predominant in the deep-water lacustrine fauna of Europe, are very abundant in individuals. Though their superficial peculiarities are in most points the same as those of deep-water European forms, the species seem to be related taxonomically rather to shallow-water Siberian forms.

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EXPLANATION OF PLATE III.

SHELLS OF LAKE BIWA.

Lithotis japonica, Preston.

FIG. 1.—Shell of the type-specimen photographed from above, × 4.
From Chikubushima, L. Biwa.

Melania multigranosa, Boettger.

,, 2.—Shells from L. Biwa.
A—C. Normal shells from shallow water.
D. Large, much eroded shell from a depth of 250 feet.
E. Dwarfed shell taken on a sandy bottom with much weed in the Oki-no-shima channel at a depth of between 12 and 20 feet.

Melania niponica, Smith.

,, 3.—Shells from L. Biwa.
A. Normal shell from near Otsu.
B. Shell of large, heavily sculptured type from Chikubushima.

Melania biwae, Kobelt.

,, 4.—Shell from Chikubushima.

Valvata biwaensis, Preston.

,, 5.—Shell of type-specimen from deeper parts of L. Biwa, × 4.

Valvata annandalei, Preston.

,, 6.—Shell of type-specimen from deeper parts of L. Biwa, × 4.

Cristaria plicata (Leach).

FIGS. 7, 8.—Young shells from L. Biwa.
The shell shown in fig. 7 is unfortunately cracked.

Anodonta woodiana (Lea).

,, 9*a*, 9*b*.—Right valve of specimen from Seta, L. Biwa.

Corbicula viola, Pilsbry.

FIG. 10.—Typical shells from comparatively shallow water.
A. Full-grown shell.
B. Half-grown shell.
,, 11.—Dwarfed shell taken in the northern part of the lake at a depth of over 260 feet.

Corbicula sandai, Reinhardt.

,, 12.—Small shell from the Oki-no-shima channel.

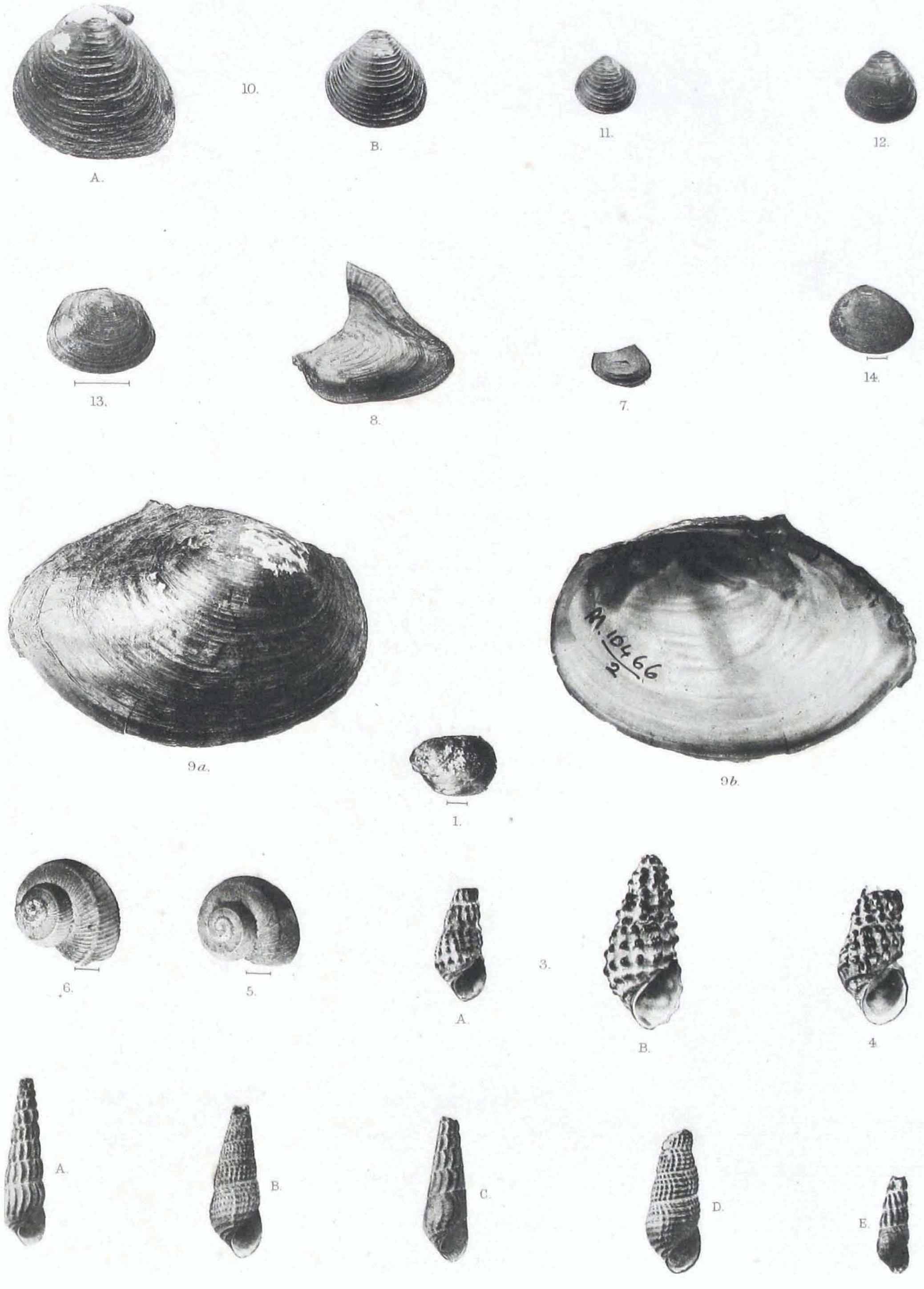
Sphaerium heterodon, Pilsbry.

,, 13.—Shell from a ditch at Hikoné, × 2.

Pisidium casertanum (Poli).

,, 14.—Shell of the form *lacustris* from the deeper parts of L. Biwa.

Except when it is otherwise stated, the specimens have been photographed of the natural size. In the case of specimens of *Melania* chalk was rubbed on the surface before the shell was photographed in order to show up the sculpturing.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MEMOIRS

OF THE

ASIATIC SOCIETY OF BENGAL

VOL. VI, pp. 75—155.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

EDITED BY N. ANNANDALE, D.Sc., F.A.S.B.

PART II.

CALCUTTA:

PRINTED AT THE BAPTIST MISSION PRESS, AND PUBLISHED BY
THE ASIATIC SOCIETY, 1, PARK STREET.

1917.

Price Rs. 5; or 7*s*.

28-7-17

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PART II.

CONTENTS.

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AQUATIC HEMIPTERA FROM THE TALÉ SAP IN PENINSULAR SIAM.

By C. A. PAIVA.

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

AQUATIC HEMIPTERA.

By C. A. PAIVA, *Assistant, Zoological Survey of India.*

The water-bugs collected by Dr. N. Annandale, though few in number, constitute a very interesting collection. The specimens were all collected either from the inner lake of the Talé Sap system or from small creeks, pools or ditches on the shore of some part of the system. Among them there is a new species of *Microvelia* (*Kirkaldya*) represented by a few apterous specimens, one of which is a male. The majority of the remaining species are very widely distributed Oriental forms. *Cercotmetus compositus* has hitherto been known only from Laos, and *Halobates sexualis* from the Siamese Peninsular province of Patani. All are true freshwater forms, except the last, which is probably estuarine.

In all there are represented six families, nine genera and ten species, besides an immature form of another species. There are two species (2 genera) of Hydrometridae, four species (3 genera) of Nepidae, two species (1 genus) of Corixidae, while the Naucoridae and Belostomatidae have each a single species. The immature specimen belongs to the family Notonectidae.

The most interesting feature of the collection is the fact that it includes specimens of a new species of the subgenus *Kirkaldya* (Genus *Microvelia*), which has hitherto been known only from North America.

Family HYDROMETRIDAE.

Subfamily *VELIINAE.*

Microvelia (Kirkaldya[1]) sexualis, sp. nov.

One apterous male and four immature females, which I assign provisionally to the same species. From near shore of the lake among flood debris on the shore of the Talé Sap, N. of Patalung River, 16-1-16.

♂. Fulvous, pronotum with a patch of black punctures on the posterior two-thirds; body and legs clothed with short stiff hairs and a few patches of silvery hairs visible in certain lights. Legs stramineous.

Head hairy, convex above, declivous in front and rounded apically; a dark, central, longitudinal, subcarinate line on disk; inner margin of eye with a silvery white

[1] *Canadian Entomologist*, XLII, 1910, p. 186.

band, outwardly margined with fuscous; eyes blackish red, the facets with a silvery tint; antennae hairy, fuscous, the basal half of the first joint much lighter; first joint robust, bent slightly outwards, equal in length to the fourth, which is stout, rounded above, flat below and tapering towards the base and apex; second and third joints each shorter than the first or fourth, subequal, slender at their bases and widening towards their apices.

Underside of head pale ochraceous; rostrum long, robust, tapering apically and extending nearly to the intermediate coxae, stramineous, the apical joint black and shining.

Pronotum fulvous, a number of black punctures arranged in an almost circular patch on the posterior area; a pale, medial, longitudinal carina on disk; lateral and posterior margins rounded; anterior margin concave; exocorium subtriangular, a strongly impressed black line extending from inner angle but not continued to the outer margin; scutellum subquadrate basal margin concave, apical margin slightly

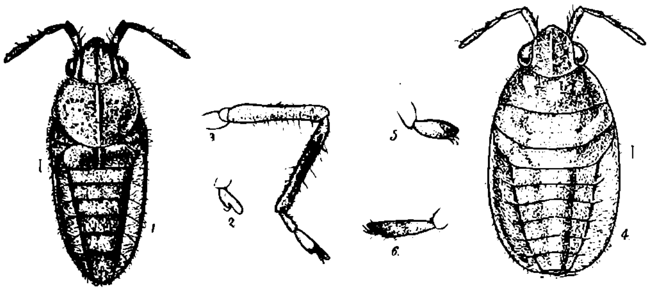

FIG. 1.—*Microvelia* (*Kirkaldya*) *sexualis*.
1. Body of apterous male. × 17. 2. Fore tarsus of male. × 22½. 3. Middle leg of male × 22½.
4. Body of immature female. × 17. 5. Fore tarsus of immature female. × 22½.
6. Middle tarsus of immature female. × 22½.

sinuate in the centre, lateral angles rounded and clothed with short silvery pubescence, basal angles excavated; four black punctures arranged in a square on disk.

Sternum flavous, a curved row of contiguous punctures on the propleura, a spot on the mesopleura and a line at the junction of the meso- and metapleura black.

Legs very hairy, especially the tibiae, stramineous; femora and tibiae with slightly suffused markings; apices of tarsi fuscous or black.

Abdomen slightly darker than the thorax, apical margins of the dorsal segments slightly blackish, clothed with fine silvery hairs; flat above, narrowing posteriorly with six visible segments, connexivum almost perpendicular slightly sloping outwards, similar in colour to the abdomen, a patch of silvery hairs at the basal angle. Underside of abdomen and connexivum, light yellowish covered with glistening hairs, the former convex below with a slight, central, longitudinal depression. Stigmata and a lateral spot at the base of each ventral segment black; segmental margins narrowly fuscous.

Intermediate femora and tibiae subequal, each equal in length to the 3 apical joints of the antennae together. Posterior femora incrassate, shorter than intermediate femora; fore tarsi single jointed, intermediate and posterior two-jointed.

Length 2 mm.; breadth between posterior pronotal angles 0·75 mm.

♀ (*immature*). Head similar in shape to that of the male, dull fuscous; two light brown patches on front; a central, black, shining, longitudinal carinate line extending along the entire length of the head; upper surface covered with fine erect hairs which are most dense and silvery at the inner margins of the eyes and at the base of the head; on each side of the medial carina are two very minute black tubercles placed obliquely in front of each eye. These are not visible in the male specimen. Antennae as in male. Underside of head stramineous; rostrum as in male, but a little shorter, scarcely passing the anterior coxae.

Pronotum hairy, dark fuscous brown with three light brown spots on the anterior area, broader than long, the anterior margin broadly concave, the posterior margin convex, lateral margins oblique. Mesonotum broader than pronotum, deeply centrally impressed by an oblique line; a patch of silvery hairs at each lateral angle; a somewhat large quadrate patch on the disk of the mesonotum, light brown; anterior lateral margins obliquely ascending. Metanotum very narrow, lateral margins oblique; a patch of silvery hairs at each outer angle; entirely dark brown.

Sternum entirely pale stramineous, slightly hairy, a thin black line between the pro- and mesopleura; a slightly thicker black line between the meso- and metapleura; this line is continuous with a black band made up of somewhat large black subtriangular lateral patches at the bases of the ventral abdominal segments and the stigmatal spots.

Legs very much the same as those of the male. Apices of the distal tarsal joints black or fuscous. All the tarsi one-jointed.

Abdomen above dark brown, outer margins of segments almost dull black; very hairy with patches of silvery hairs which are visible in certain lights; connexivum yellowish brown, extending obliquely outwards.

Underside of abdomen and connexivum pale yellowish, hairy.

Length.—2 mm.; breadth between posterior pronotal angles, 1 mm.

Subfamily *GERRINAE*.

Halobates sexualis, Distant.

1903. *Halobates sexualis*, Distant, W. L., *Fascic. Malay. Zool.* I, p. 258, pl. XV, figs. 10, 10a, 10b (♂ and ♀).

Three male specimens (one pinned and two in alcohol) from near Pak Payun, Talé Sap, 18-i-16.

In Distant's figure the length of the head appears to be less than the distance between the inner margins of the eyes while in the Siamese specimens the head is longer than broad and is about twice as long as the pronotum.

As Carpenter[1] considers the "horns" of the 8th abdominal segment in the males of *Halobates* to be of specific importance, an outline drawing of the ventral apical segments of one of the specimens in alcohol is here reproduced.

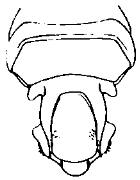

FIG. 2.—*Halobates sexualis*. Ventral view of male genitalia. × 22½.

It will be seen that the "horns" are symmetrical as is the case in *H. flaviventris*, Esch., but the "process" on the outer margin, near the middle of each is bluntly produced and the "horns" overlap the egg-shaped 9th abdominal segment a little before their apices, which are acutely pointed.

Fam. NEPIDAE.

Laccotrephes ruber (Linn.).

1906. *Laccotrephes ruber*, Distant, W. L., *Fauna of British India, Rhynchota*, III, p. 18.

One specimen from a small pool or ditch at the edge of the lake, Talé Sap, Patalung, 14-i-16. Compared with Indian specimens identified by Distant.

Laccotrephes griseus (Guer.).

1910. *Laccotrephes griseus*, Distant, W. L., *Fauna of British India, Rhynchota*, V (Appendix), p. 314.

One specimen from a small creek at Pok Raw, Talé Sap, 18-i-16. Compared with Indian specimens identified by Distant.

Ranatra filiformis, Fabr.

1906. *Ranatra filiformis*, Distant, W. L., *Fauna of British India, Rhynchota*, III, p. 21.

Six specimens from a small pool or ditch at the edge of the lake, Talé Sap, Patalung, 13-i-16. Compared with Indian specimens identified by Distant.

Cercotmetus compositus, Montd.

1903. *Cercotmetus compositus*, Montandon, A. L., *Bull. Soc. Sci. Bucarest*, XII, p. 109.

Two specimens. One from a small pool or ditch at the edge of the lake, Talé Sap, Patalung, 13-i-16, another from Koh Si Hah, Talé Sap, Singgora Province.

I have not been able to compare these specimens with the original description of this species, but on reading Montandon's discussion on the described species of *Cercotmetus* on p. 63 of *Ann. Hist.-Nat. Mus. Nat. Hung.* (Budapest, 1909) VII, I have no doubt about their identity.

At the time they were collected both specimens were placed in alcohol. Lately I removed one, pinned it and while still wet immersed it in crude benzine where it was allowed to remain till the benzine ceased to be turbid, by which I concluded that all the alcohol had been drawn out of the insect. I then removed it and immediately

[1] Carpenter, G. H., *Ceylon Pearl Fisheries*, V, *plate*, figs. 5-7 (1906).

placed it on a heap of perfectly dry plaster of Paris powder and entirely covered it with the same. After it had remained in the plaster for about a couple hours the insect was thoroughly dusted with a rather stiff sable hair brush. This treatment prevents the hairs on the body and legs from lying flat when specimens are taken out of alcohol and pinned.

Apart from the pinned specimen becoming slightly darker than the one in alcohol, the two do not differ from one another.

The colour of the hairs on the apices of the femora, on the tibiae and on the tarsi of the intermediate and posterior legs is not entirely yellow as it is in the species mentioned by Distant in the Fauna, but it varies according to the colour of the part of the legs to which they are attached, that is those on the yellowish parts are yellowish and those on the darker parts are blackish.

There are two parallel rows of hairs on the tibiae of the intermediate and posterior legs.

The hairs on the outer parts of the anal appendages are also dark.

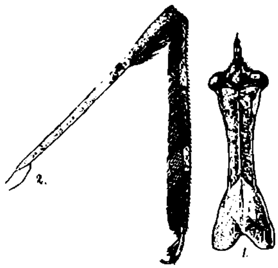

FIG. 3.—*Cercotmetus compositus.*
1. Head and thorax. × 2.
2. Hind leg. × 2.

In the alcohol specimen there are three very small, conspicuous, black tubercles on the outer margin of the connexivum, placed almost above the middle of the 2nd, 3rd and 4th abdominal segments respectively. In the dried specimen these tubercles are very indistinct.

The points on which I have relied for the identification of these specimens are:—the pronotum is wider posteriorly than anteriorly; the interocular tubercle is obtuse or blunt, not pointed; the membrane is well-developed, passing the apical angle of the corium and covering about half the apical abdominal segment; the intermediate femora are longer than the head and pronotum together; the mesosternum is plain, the metasternal carina not reaching it.

Family NAUCORIDAE.

Naucoris sordidus, Dist.

1910. *Naucoris sordidus*, Distant, W. L., *Fauna of British India, Rhynchota*, V (Appendix), p. 325, text-fig. 186.

One specimen from a small pool or ditch at the edge of the lake, Talé Sap, Patalung, 13-i-16.

This specimen agrees very closely with Distant's description of *N. sordidus*, but his figure does not agree with specimens he has identified, especially with regard to the markings on the connexivum, which in the specimens are identically the same as those in the figure of *N. vividus* (p. 326). I have no hesitation in identifying the Siamese specimen as *N. sordidus* as the markings on the pronotum resemble those in the figure of *sordidus* rather than those in that of *vividus*.

Family BELOSTOMATIDAE.

Sphaerodema rusticum (Fabr.)

1906. *Sphaerodema rusticum*, Distant, W. L., *Fauna of British India, Rhynchota*, III, p. 36, text-fig. 23.

One adult and two immature specimens from a small pool or ditch at the edge of the lake, Talé Sap, Patalung.

Compared with Indian specimens identified by Distant.

Family CORIXIDAE.

Micronecta merope, Dist.

1910. *Micronecta merope*, Distant, W. L., *Fauna of British India, Rhynchota*, V (Appendix), p. 345, text-fig. 213.

One specimen from the mouth of Patalung River at Lampam, Talé Sap, 15-i-16. Compared with Indian specimens identified by Distant.

Micronecta lucina, Dist.

1910. *Micronecta lucina*, Distant, W. L., *Fauna of British India, Rhynchota*, V (Appendix), p. 345, text-fig. 207.

Two specimens from the mouth of the Patalung River at Lampam, Talé Sap, 15-i-16.

This apparently is a very variable species. The anterior fuscous line on the pronotum in the typical form is broken only in the middle, but in the Siamese specimens it is broken up into four or five round spots. This also is the case in two specimens taken at light at Madhupur, Bengal, which have been identified by Distant. The length of the head also does not always appear to be nearly half the width between the eyes; in some specimens it is as long, if not longer, than the space between the eyes.

Family NOTONECTIDAE.

Anisops sp. juv.

One specimen from a small pool or ditch at the edge of the lake, Talé Sap, Patalung, 13-i-16.

Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

AQUATIC OLIGOCHAETA FROM JAPAN AND CHINA.

By J. STEPHENSON, *D.Sc., Lt.-Col., I.M.S., Professor of Zoology, Government College, Lahore.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

AQUATIC OLIGOCHAETA FROM JAPAN AND CHINA.

(Plate IV.)

By J. STEPHENSON, *D.Sc.*

The following paper describes the Oligochaete worms present in ten tubes brought back by Dr. Annandale from his recent tour. Of these, one was from China; one, containing a quantity of worms sold as food for goldfish, was from Kyoto; and the rest from Lake Biwa.

It is unfortunate that so many of the specimens from Lake Biwa were sexually immature and therefore unidentifiable. This was the case with the whole of the contents of four out of the eight tubes as well as with a number of specimens in some of the others. Some of the immature worms, from their similarity to other sexual specimens in the collection, have been identified with these with more or less of probability; but at least one species of Tubificid and two of Lumbriculid remain. The Tubificid was found at the deepest point of the lake, 320 ft.; the Lumbriculids at 180, 200, 250, 260 and 320 ft.

Of the species which have been identified or newly described *Chaetogaster annandalei* was found within a sponge at a depth of 15 ft.; *Kawamuria japonica* at depths of 260 and 320 ft., and worms probably to be referred to the same species at 250 ft., as well as in shallow water, 6–27 ft.; *Criodrilus bathybates* comes from a depth of 180 ft.; *Limnodrilus socialis* from ditches; and *Branchiura sowerbyi* from 1·75 metres in Lake Tai-Hu, Kiangsu Province, China, as well as from ditches (along with *Limnodrilus socialis*).

GENERAL REMARKS.

Before proceeding to the systematic description of the new species, I may perhaps be allowed to set down a few remarks of more general interest.

(1) *Chaetogaster annandalei.* The genus *Chaetogaster* is already known as a commensal in Sponges. Annandale (1) describes *C. spongillae* in *Spongilla carteri* and *S. decipiens* in Calcutta; it frequents only those parts of the sponge that are dying or dead, its food apparently consisting of the organic debris left by their decay; the healthy, growing parts are quite free of them. Only a few specimens of the present species were found in the small sponges from Lake Biwa submitted for examination; but in this case the sponges were young and compact.

Chaetogaster is also frequently commensal on or in the shell of freshwater Gastropods; one species (*C. limnaei*) may be endoparasitic in the liver of certain Pulmonata; others, however, live freely.

(2) I propose to discuss here the "coelomic sac" of *Kawamuria*, which, as also in *Branchiura sowerbyi*, surrounds the terminal part of the male deferent apparatus.

The sac is ovoid, completely closed, planted on the ventral body-wall over the situation of the penis; it possesses a muscular wall of some thickness. Its probable function, which I take to be the extrusion of the penis, will be understood from fig. 2. The penis is a pear-shaped bladder-like organ, the space between the axial ejaculatory duct and its outer wall being free from the strands which, in other genera with a penis, frequently form a connection between the two. Its extroversion would be effectively brought about by the contraction of the walls of the coelomic sac and the forcing of fluid into this space.

It is difficult to guess any other function for the sac; and it seems not unlikely that sac and penis have evolved together as a connected whole.

But among Tubificids a similar sac occurs elsewhere only in *Branchiura*; and there can be no doubt, on other grounds, that *Kawamuria* and *Branchiura* are closely related; *Kawamuria* might be described as a *Branchiura* without gills and with a penis. But if, as just implied, *Branchiura* has the sac but no penis, what must be the nature of the relationship? It can only be that *Branchiura* has lost a penis that it formerly possessed; since (taking for granted the function of the sac as explained above) we cannot credit *Branchiura* with having produced a sac in the expectation of a penis to follow. In other words the sac in *Branchiura* is a vestigial organ.

There are possibly a few indications of this in its structure; it appears to be somewhat less ample than in *Kawamuria* (cf. figs. in Michaelsen, 13, and Stephenson, 17); the wall is also not particularly strong (seine Wandung ist dünn, mit zarten Muskelsträngen ausgestattet), and is certainly thinner than in *Kawamuria*.

If the above reasoning is correct, *Branchiura* would be a direct descendant of *Kawamuria*, by loss of penis and development of gills. (On the systematic aspect of the connection between the two forms v. inf.).

(3) *Criodrilus bathybates* is remarkable on account of the depth (180 ft.) at which it is found. A certain number of the Lumbricidae, as well as scattered examples in other terrestrial families of the Oligochaeta, may be found regularly or occasionally in marshes, ponds and streams,—usually on the banks or near the shore,—while more than one subfamily of the Geoscolecidae are partly, and the Criodrilinae wholly, limnic; but even these latter seem to occur for the most part in shallow water only. The occurrence of one of the "Megadrili" at the depth of 180 ft. is probably very exceptional, though without going through the literature of all the limnic forms I could not say that it was unique. But it is noteworthy that in L. Baikal, where a systematic investigation of the whole fauna was carried out, no Megadrili at all were obtained, though Microdrili,—Tubificids, Lumbriculids and *Haplotaxis*,—were present at depths even below 1,000 metres. (Michaelsen, 11).

With this deep-water habitat, in the case of *C. bathybates*, is probably to be correlated the absence of a gizzard. While this organ is present, though rudimentary, in other members of the genus and subfamily, it appears to be entirely wanting here; the examination of a series of microscopic sections might perhaps have given some indication of a thickening of the oesophageal wall in one or other segment, but with only two specimens available I did not undertake this. Mud, being softer and in a finer state of division than earth, needs less grinding up; hence, supposing limnic Megadrili to have originated from terrestrial forms, the gizzard would regress from disuse in the former. So Michaelsen, on the Geoscolecid-Lumbricid group in general (9):—"Einzelne Abtheilungen....rein limnisch sind und, wahrscheinlich in Folge dieser Lebensweise, gewisse Organe....zurückgebildet oder ganz abortirt zeigen. Diese Rückbildung betrifft besonders den Muskelmagen und manchmal auch die Samentaschen." And while the coarser sediment is deposited in the shallower water near the shores, it is only the finest particles that are carried out to the depths; hence the deeper the habitat, the more vestigial we should expect to find the gizzard.

(4) Limnic forms have not as a rule much zoögeographical value. Thus the genus *Chaetogaster* is cosmopolitan.

Michaelsen (13) supposed that *Branchiura sowerbyi* was possibly originally an inhabitant of the tropics, since when he wrote the worm had been found only in artificially warmed water in Botanical Gardens. But it has since been found in natural surroundings in France, and in extratropical India where hoarfrost lies on the ground in the mornings for some weeks in the year, as well as now in China and Japan; and one of the latter countries has perhaps as good a claim as any other to be considered as its place of origin, since *Kawamuria*,—a close relative, or even, as I have argued above, possibly its immediate ancestor,—lives also in Japan. It is at any rate a curious coincidence that the two worms should occur in the same small collection of only half a dozen identifiable forms. But it is unwise to lay stress on isolated facts of this kind; a related genus, *Bothrioneurum*, is represented by one species in the Malay Peninsula, one in S. America, and one in Austria; and both *Kawamuria* and *Branchiura* may have a wider distribution than appears at present.

Species of *Criodrilus* are known from S. America and Costa Rica, and the genus also includes the fairly common *C. lacuum*, found in Central Europe and extending to Syria and Palestine and doubtfully also to India. No species of *Criodrilus* however was found in Lake Baikal, or in the Teleckoë Lake in the Northern Altai (Michaelsen, 10); and it is impossible to say whether the forerunners of *C. bathybates* reached Japan from the direction of America or from that of Europe, or whether the present species is a relic,—the area of distribution of the genus *Criodrilus* having perhaps been at one time circummundane. Michaelsen looks on the Geoscolecidae as having had previously a more extensive distribution, the terrestrial members having (in the Old World) given way before the younger branches of the Megascolecid tree, and especially before the expanding Lumbricidae (Michaelsen, 9). Only the limnic divisions of the family have been able to maintain themselves in the territory which has been appropriated by their younger rivals. A depth of 180 ft. may be supposed to have removed the present species out of the region of competition.

Fam. NAIDIDAE.

Chaetogaster annandalei, sp. nov.

N. Lake, L. Biwa, Japan[1]: 15 ft. In *Spongilla lacustris*, growing on leaves of *Potamogeton*. 29-ix-1915.

The sponges did not apparently form a very favourable residence for the worms: they were young and compact, and the worms were few,—none might be found on teasing up a whole sponge. Had the sponges been older and disintegrating the *Chaetogasters* might have been more numerous.

The worms are minute, a single individual being only ·44 mm. in length, and a chain of two ·66 mm. In diameter they measured ·13 mm. $n = 10$ or 11.

There is a well-marked prostomium, i.e. the anterior end of the animal extends forward in front of the margin of the mouth aperture, which is thus on the ventral surface; in a number of the other species of the genus the anterior margin of the mouth coincides with the tip of the snout. The prostomium is here a bluntly triangular projection.

There is a distinct constriction behind the second segment, and thus the appearance of a head is produced; this "head" is small, about two-ninths of the length of the animal (or of the first animal of the chain), and rather conical in shape, broadest behind. The appearance is given of a fairly strong septum behind the "head," but this was not confirmed in sections.

There are no dorsal setae. The number of setae in the ventral bundles is small, 4 or 5 in the second segment (where they are directed forwards), and 3, or often only 2, in the hinder part of the body. They are absent, as usual, from the third to the fifth segment inclusive. In length the setae of the second segment measure 70 , and those of the other segments 50 to 60μ; in thickness they are about 1·5μ. They are double-pronged, but the prongs are very fine and not distinctly visible with the ordinary high power of the microscope; with the oil immersion they are seen to be of unequal length, the distal being the longer and more curved. The shaft is only slightly and gently curved at both ends; the nodulus is markedly proximal to the middle of the shaft, the proportions being about 3 : 4.

The oesophagus is quite short, and is succeeded by a much dilated "crop," the hinder part of which is opposite the setae of segment vi; or the chief swelling of the alimentary canal may be posterior to this, so that there is a small "crop" and a large "stomach."

The heart is situated dorsal to the oesophagus, in segment iii or in iii and iv. There is apparently no refractile body in the cerebral ganglion, such as has been noticed in a number of the other species of the genus.

Remarks. The minute size of the animal, together with the short oesophagus and the small number of setae per segment, will suffice to distinguish the present form.

[1] Since the above account was written I have found the same species, also from a sponge, in a collection made by Dr. Annandale at the Inlé Lake, Southern Shan States. 24-iv-1917.

Fam. TUBIFICIDAE.

Branchiura sowerbyi, Beddard.

Channel S. of Tong Dong Ding, Tai-Hu, Kiangsu Province, China; 1·75 metres. Several specimens.

Ditches near Kyoto, Japan (along with *Limnodrilus socialis*), one complete and two incomplete specimens.

The anatomy of this interesting form is now well known; besides the original description of Beddard, there are accounts by Michaelsen (13), Stephenson (16, 17), and Keyl (7). Remarks on its affinities may conveniently be subjoined to the discussion under *Kawamuria*.

Dr. Annandale informs me that in the Tai-Hu, which may have been formerly connected with the sea, though now forty miles away and with no direct connecting channel, the water is quite fresh; but notwithstanding, the only worm taken in the open part was a Polychaete. The specimens of *Branchiura* were dredged in a narrow channel between two islands, where vegetation was much more abundant.

The curious fact may be noted that *B. sowerbyi* and *Limnodrilus socialis* were found in the same pool in Lahore (16), that I received specimens of both on the same day from Calcutta, both having been taken within the precincts of the Museum (17), and that now they are again found together in the same tube from Kyoto.

Kawamuria japonica gen. et sp. nov.

L. Biwa, Japan; the deepest point in the lake, near Chikubushima, 320 ft., on a bottom of fine mud. Numerous specimens, nearly all immature and many fragmentary.

The same place; near White Rocks in central part of the lake; 260 ft., on a bottom of mud with fragments of shell. A number of specimens, mostly fragments, and immature.

Immature Tubificids from the following stations on the lake are probably to be referred to the same species:—

Channel between N. and S. Lakes, 6—27 ft.: bottom of soft mud with a certain amount of weed.

Off Komatsu, near middle of lake, 250 ft.; bottom of firm mud, no weed.

External Features.

Length of a complete specimen about 50 mm.; thickness 1 mm. The worms are squarish in transverse section, with the setae at the angles. The anterior part of the body is yellowish and opaque; behind the genital region the worm is darker, probably due to the thinner body-wall allowing the intestinal contents to modify the colour. The genital products appear as yellowish masses as far back as segment xviii.

The prostomium is bluntly triangular. A number of the anterior segments are more or less distinctly bi- or triannulate.

The clitellum includes the posterior third of segment x and the whole of xi and xii.

On segment xi are seen two pores, each encircling the base of a penis, which projects as a somewhat irregular semitransparent bladder-like sac. Each penis is situated within the line of the ventral setal bundles and not far from its fellow of the opposite side. There are no penial setae. The spermathecal apertures are just behind the ventral setae of segment x.

The dorsal setae begin in segment ii and consist of hairs and needles. The hairs are usually one per bundle, rarely two, and occasionally they may be absent from a bundle; they are comparatively short,—about ·37 mm. long, or not more than about twice the length of the needles. The needles vary somewhat in length; in segment v they were measured as being ·2 mm., and further back ·15 mm. The distal end terminates in a single point (fig. 1*a*); the nodulus is slightly distal to the middle of the shaft (in the anterior segments), or (further back) at the middle. The total number of setae per bundle is seven or eight in the most anterior segments, soon diminishing to six, five, four or even three.

The ventral setae begin in segment ii and are absent from xi. They are needles with the usual double curve, five to nine per bundle in the anterior part of the body and three or four behind the genital region. In length they measure ·18 mm., and the nodulus is very slightly distal to the middle of the shaft; the tip is blunt and single as a rule, but may show two short stump-like points (fig. 1*b*).

INTERNAL ANATOMY.

The alimentary canal is but little differentiated after the pharynx.

The dorsal vessel is ventral in position from its hinder end as far forwards as the clitellar region; the dorsal and ventral vessels may be seen in transverse sections as a pair of canals one on each side of the ventral nerve cord. There is one pair of hearts in segment ix.

As in *Branchiura sowerbyi*, a striking feature of the ventral nerve cord is the size of the giant fibres. Of these there are two which in places reach a really enormous thickness, and in addition one or two others are seen of much smaller size. In the middle of the body the nerve cord has, in one section, a transverse diameter of ·072 mm., while the largest giant fibre measures ·046 mm. in its longest diameter; in segment xiii the cord is ·123 mm. in transverse diameter, and the largest fibre ·05 mm. The giant fibres are however of irregular thickness, and are especially contracted where the cord passes through the septa.

The testes, in segment x, attached to septum 9/10 near the ventral body-wall, are large and tend to be folded round the spermathecae. The ciliated funnel is a large irregular folding of the anterior face of septum 10/11. The anterior spermsac, in ix, is single, small, and situated dorsal to the alimentary canal; the posterior, also single, extends back as far as segment xvii.

The male deferent apparatus is shown diagrammatically in fig. 3. The vas deferens begins as a wide tube, 40μ in diameter at its commencement behind septum 10/11; passing backwards on the inner side of the coelomic chamber, to be described later, it becomes surrounded by a cellular "prostatic" investment—a large mass of cells enveloping the vas deferens, atrium and paratrium; curving upwards, and while surrounded by the prostate, the vas deferens joins the posterior wall of the atrium about or slightly above the middle of the height of the latter, piercing its wall obliquely. The lining of the vas consists of heavily ciliated cubical cells.

The atrium is a cylindrical chamber, ·08 mm. in diameter, which lies obliquely in segment xi; its hinder end, directed posteriorly and dorsalwards, reaches nearly to the dorsal parietes; its lower and anterior end narrows gradually at first, and then suddenly, to become the ejaculatory duct. The whole of the atrium is enclosed within the mass of prostatic cells, with the exception sometimes of the blind end, which may be bare. The blind end as far down as the entrance of the vas deferens is lined by high ciliated epithelium; in the remaining portion the cells are non-ciliated, clearer than higher up, with a more densely staining cytoplasm (eosin). There is a granular coagulum in the lumen.

The paratrium is also a more or less cylindrical chamber, ·06 mm. in diameter, lying roughly parallel to the atrium, and like it enclosed in the prostatic mass. Its lower end is the narrower,—two-thirds the diameter of its upper portion; it is continued below into the paratrial duct, which joins the ejaculatory duct shortly after the latter has entered the coelomic chamber. Its epithelium varies in character from cubical to low columnar; it is not ciliated. The lumen contains a homogeneous coagulum. The paratrial duct, with a small or even potential lumen, has a thickness of 30-40μ, is lined by a non-ciliated epithelium, with deeply staining nuclei, and has a strong muscular investment.

The ejaculatory duct is enclosed in its whole length in the "coelomic chamber" (figs. 4, 5), a sac with muscular walls, ovoid in general form, which is implanted on the ventral body-wall and reaches to about half the height of the body; the mass of prostatic cells impinges on or gets an attachment to the upper part of the sac. The duct is suspended in the sac by a stout band of muscular fibres,—not only the band but also the individual fibres are stout; the suspensory band and the fibres of the sac-wall are continuous with a vertical strand which passes upwards through the segment and is attached to the dorsal body-wall. The duct winds considerably in the upper part of the coelomic sac; it has a non-ciliated cubical epithelial lining and a prominent muscular coat; its diameter, 40μ at first, diminishes further down to about 27μ.

The "prostatic cells," which have a close histological resemblance to the "pharyngeal gland cells," do not seem to be more than applied to the organs they surround; they thus represent an overgrowth of peritoneal cells, and do not discharge into any part of the lumen of the male deferent apparatus. The whole, with the organs contained within it, constitutes a bulky irregular mass which takes up a large part of the segment.

The projecting portion of the penis (fig. 5) is shown by sections to be as it appears in entire specimens, hollow and bladder-like; its covering epithelium is short, not columnar like that of the general surface of the body; it contains a central tube, the continuation of the ejaculatory duct, which opens at its free extremity. The space included between its outer wall and the duct which runs through its centre is a portion of the coelom continuous with that included in the coelomic sac; and the function of the sac is apparently, by the contraction of its muscular wall, to produce the extrusion of the penis (cf. fig. 2). The penis arises from the bottom of an invagination of the surface, which may be called the penis-sheath.

The ovary is particularly bulky; attached anteriorly to septum 10/11 near the ventral body-wall, it extends backwards behind the prostate, and pushes septum 11/12 back to the level of 12/13; it appears to be suspended by strands which pass dorsoventrally.

The ovisac is extensive, reaching as far as segment xviii. The funnel is a slight modification of peritoneal epithelium on both septum 11/12 and the adjacent body-wall; the cells are small, cubical or low columnar, compacter than the usual peritoneal lining, thrown into folds, non-ciliated and with deeply staining nucleus. The duct passes straight down through the body-wall, and thus opens in groove 11/12.

The ampulla of the spermatheca is of an inverted pear-shape, broad in comparison with its height; the narrower portion, the stalk of the pear, is above. The whole is placed vertically in the segment and reaches to not far from the dorsal parietes. There are no spermatophores, the contents consisting of a mass of matted spermatozoa. The duct, nearly equal in length to the ampulla, is broad and patent, and almost straight or somewhat bent forwards. The epithelium of the ampulla is cubical to columnar; that of the duct is irregular in height, and the lining thus appears to be thrown into folds.

Remarks. The genus to which the above species is most closely related is *Branchiura*,[1] at present represented only by one species, *B. sowerbyi*.

In the main features of its anatomy *K. japonica* agrees with *B. sowerbyi*, as well as in possessing such a special character as the coelomic sac enclosing the terminal portion of the male deferent apparatus. This structure, known hitherto only in *B. sowerbyi*, seems to be of considerable morphological value; other peculiarities common to both,—the enormous size of the giant fibres of the ventral nerve cord, and the ventral position of the dorsal vessel,—may not have the same significance.

It differs from *B. sowerbyi* in the absence of gills and in the presence of a well-marked penis, as well as in the possession of only a single pair of hearts, in segment ix, instead of two pairs, in ix and x. The last point is perhaps of no great value, but the other two appear to be of more importance.

It is true that Michaelsen has more than once expressed the opinion that the presence of gills is not of much morphological weight. So in 1900 (8) he united *B. sowerbyi* and *Ilyodrilus coccineus* in the same genus, in spite of the absence of gills in the latter. In 1908 he writes (13): "Die Kiemen der *Branchiura* sind ja nichts

[1] The limits of the genus *Branchiura* have undergone several changes. Established in 1895 by Beddard (2) for *B. sowerbyi*, largely on account of the presence of gills, it was united by Michaelsen in 1900 (8) with the worm known as *Tubifex* or *Ilyodrilus coccineus*, and in 1905 (12) with *Taupodrilus* (Benham, 1903, 4); in bringing these various worms together, Michaelsen was guided by the comparatively small importance he attributed to the presence of the gills in Beddard's species. His view was accepted by Benham, who in 1907 (5) described another species, similar to his previous species of *Taupodrilus*, as *Branchiura pleurotheca*. In 1908 Michaelsen (13) himself obtained *B. sowerbyi*, and subjected it to examination, with the result that he found Beddard's description to be erroneous in certain respects, especially in making no mention of the paratrium,—a blind tubular diverticulum of the atrium; it thus became necessary again to separate *Branchiura* from the other species, which (including *I. coccineus*) resume the name *Taupodrilus*. In 1909 Michaelsen (14) gives the presence of gills, the presence of paratrium, and absence of penial setae as generic characteristics, as against *Taupodrilus*, which has penial setae, but no gills or paratrium.

anderes als einfache Ausstulpungen der Hypodermis, in die eine Schleife des integumentalen Blutgefäss-Netzes mit hineingezogen ist. Das sind keine Bildungen von morphologisch sehr bedeutsamen Charakter"; and again in the same paper "(the gills) höchstens artliche Bedeutung haben; sind sie doch nur eine Anpassung an die Sauerstoff-Armut warmer stagnierender tropischer Gewässer." However he later (14) places the presence of gills among the generic characteristics of *Branchiura*; and in another family, the Naididae, gills of the same kind as those of *Branchiura* are well recognized as constituting a character of generic value (*Branchiodrilus*, *Dero*, *Aulophorus*); a *Dero* without gills would be a *Nais*.

The presence of a penis however (as distinguished from a pseudopenis, which arises by evagination of the simple tubular end of the atrium, and disappears on retraction) is certainly of considerable importance (Michaelsen, 13), and a character of generic value. I think therefore that there can be no doubt that the present form is to be separated from *Branchiura*, though this is pretty certainly its nearest relation; and I name it after Dr. T. Kawamura, the zoologist in charge of the Otsu Lake Laboratory.

The affinities of *Branchiura* to other genera have been touched on by Michaelsen (13). He supposes a close relationship to *Bothrioneurum*. Both fall into the section of the Tubificids which are characterized by the possession of a diffuse "prostate" covering the vas deferens (or part of it); and both are included in the much narrower section which possesses a paratrium. The only essential difference between the two is, according to this author, the presence of gills in *Branchiura* and their absence in *Bothrioneurum*; and he doubts whether this is sufficient to justify a generic separation ("ob der Besitz von Kiemen ausschlaggebend fur die generische Absonderung der betreffenden Arten sein darf, will mir zweifelhaft erscheinen"). But Michaelsen omits to mention the absence of spermathecae in *Bothrioneurum*, and the presence of spermatophores (which are probably characteristic for the genus, though not yet demonstrated for *B. americanum*, cf. Beddard, 3). And if it is true, as suggested above, that *Branchiura* is descended from ancestors which possessed a penis (*Bothrioneurum* presumably never had one), the distinction between them is still further widened. The coelomic sac, at any rate, constitutes an additional feature of *Branchiura* which is not found in *Bothrioneurum*.

There can of course no longer be any question of an affinity between *Branchiura* and *Taupodrilus*, with which, prior to the discovery of the paratrium, it was confused.

Limnodrilus socialis, Stephenson.

In ditches round the city of Kyoto, Japan; sold as food for goldfish. Numerous specimens.

In 1899 Hatai (6) published the description of a worm found in Tokyo, which he called *Limnodrilus gotoi*. In 1912 I published (16) an account of a species of *Limnodrilus* which I called *L. socialis*; the worm is common in Lahore, and later in the same year I recorded having received it from Calcutta (17); subsequently it was found in a collection made by Annandale in Ceylon (18). In 1913 Nomura (16), having investigated the three species of *Limnodrilus* found in and near Tokyo, concluded that Hatai had confused more than one species under the name *L. gotoi*, since that author's description did not correspond in certain essential points with any form which was actually found, but appeared to represent a combination of features from two separate species. He retained the name *L. gotoi* for one of them, and called the other *L. willeyi*. A *Limnodrilus* from Ceylon, received through Dr. Willey, then resident in Colombo, is stated in the same paper to be identical with *L. gotoi* as newly defined by the author. In a postscript to his paper Nomura states that he is of opinion that *L. socialis* and his *L. gotoi* are identical.

With regard to Nomura's criticism of Hatai's description, it appears to me to be rather daring to suppose a confusion on Hatai's part between two species which are really (if Nomura is right) so very distinct as his *L. gotoi* and *L. willeyi*. To mention only the most striking points of difference, the two species are at variance in the matter of the anterior sperm-sac (single in one, double in the other), in the presence or absence of spermatophores, and in the length of the chitinous penis-sheath (3—4 times as long as wide in one, 10—11 times in the other); the last two characters at least are of extreme importance either in the differentiation of Tubificids in general or of the species of this particular genus. Hatai remarks that his worm "occurs abundantly in ditches and gutters of this city (Tokyo) throughout the year"; otherwise the fact that such a form was not found in Nomura's collections would be no proof that such a form does not exist; since his collections were made many years subsequently to Hatai's, and Limicolae have a way of disappearing suddenly from a locality and leaving no trace. I found *Branchiodrilus hortensis* for a few weeks in Lahore some years ago, but have never met with it here since; and if I concur in Nomura's conclusion, it is partly because his knowledge of the localities and local conditions enables him to speak with some authority. Hatai's two figures of the chitinous penis-sheath however certainly do seem to belong to two different animals.

The next point is Nomura's identification of his *L. gotoi* with my *L. socialis*. The only differences on which he comments are those relating to the "septal sacs"; which appear to have a slightly different distribution and relative size; and to the dorsal blood-sinus on the intestine in segment ix, absent in his specimens, present in mine. These are points of slight morphological importance, the septal sacs being, as I believe, only aggregates of modified peritoneal cells and the sinus (observed by me principally in the living condition, where the colour of the blood renders it more easily visible) contracting or perhaps disappearing as a definite space in the preserved specimens. There are a number of other unessential differences; but there also two of much greater importance, which Nomura likewise leaves out of the discussion altogether.

Firstly, the figures of the chitinous penis-sheath do not suggest the same shape, Nomura's showing a flange-like expansion round the open end, mine (a section) a strongly upturned margin on one side only; nor do the descriptions seem altogether to correspond. The difference is in some degree due to the mode of presentation; I give herewith (fig. 7) a figure of the isolated penis-sheath of one of the present Kyoto specimens, drawn under the camera lucida, which explains how the marked upturning of one lip may co-exist with a flange-like expansion of the margin (there seems however to be really no such expansion at the posterior margin of the end of the tube).

Secondly, I stated that the dorsal vessel was ventral in position, lying near and to the left side of the ventral nerve cord, and was only actually dorsal in the first eight segments. Nomura finds that it is near the ventral vessel in the segments containing the genital organs, but "behind these segments it reassumes its position on the dorsal side." And to this may be added that Nomura makes the supraintestinal vessel originate from the dorsal vessel in segment v, and open into it again at the hinder end of the body; in my previous species the supraintestinal was (as usual) confined to a few segments, from v to ix (though another vessel could be traced on the right side of the intestine as far back as xxi). As I was particularly interested in the circulatory system of the Oligochaeta, and especially of the Microdrili, at the time, I think these statements may be accepted (see also 19).

Notwithstanding that Nomura does not bring forward the real points of difference at all, I believe he is right in saying that the worms are the same. I have carefully examined a number of the Kyoto specimens, and I have no doubt that they at least are the same as my *L. socialis*; the dorsal vessel is ventral throughout, except in the most anterior segments (fig. 6); the end of the penis-sheath shows a strongly upturned margin on one side (fig. 7); and there is no trace of a supraintestinal vessel in the middle of the body (fig. 6), though a section is perhaps scarcely conclusive evidence on this point.

Now the species which I received from Kyoto is apparently common,—the specimens were bought in the market, where they were sold as food for goldfish,—and it must certainly have been represented among Nomura's three species,—the only species of *Limnodrilus* in his "fairly extensive collections made in different localities in Tokyo." Of these three, the one in which the length of the penis-sheath is 30—33 times its breadth, and the one in which it is 3—4 times, cannot enter into consideration; hence I believe I am justified in assuming that the form I have received from Japan is his form B (penis-sheath 10 - 11 times as long as broad) to which he restricts the name *L. gotoi*.

The last question concerns the nomenclature of this species. The rule is that when a species is divided into two or more restricted species, the name of the original species must be retained for one of the restricted species. I take it that the rule refers to cases where the original account or diagnosis is a valid description of some group of forms, which by a further refinement of observation is shown to be divisible; the original description includes both. In the present case the original description is (according to Nomura's supposition, which I have accepted) not a valid description of any form or group of forms whatever, and includes neither species (since taking some characters from one, some from another, it is at variance with both). The only course is therefore to drop the name (unless it should hereafter be shown that a form corresponding to the description does actually exist).

If this is done, the name of the species which I have previously described from India and Ceylon, and have now received from Kyoto, and which Nomura describes as *Limnodrilus gotoi*, Hatai emend. Nomura, remains as *Limnodrilus socialis*,[1] Stephenson.

Fam. GEOSCOLECIDAE.

Criodrilus bathybates, sp. nov.

Off Komatsu, about half a mile E. of Komatsu Point, L. Biwa, Japan; 180 ft., on a bottom of mud mixed with pebbles and many shells. Four specimens, all incomplete; two wanted the posterior and two the anterior end. The two anterior fragments apparently in an early stage of sexual maturity.

External Characters.

The length of the longest fragment was 123 mm., and the thickness of the body at its maximum 2 mm. The surface of the worms is a smooth shiny yellowish grey. The transverse section of the body is circular for the greater part of the length, but the hinder end is rather flattened, especially near its extremity, where the dorsal surface is concave and forms a broad shallow groove. The anus is terminal, and, in one of the two specimens which showed it, was seen to be flanked by prominent lateral lips. The nephridia appear as indistinct opaque white masses through the thin body walls.

In the longest fragment there were 165 segments.

The prostomium is large, prominent and zygolobous.

There are no dorsal pores.

The setae are small and closely paired; the relations are the same throughout the body; $aa=bc$, but dd is rather greater, about $1\frac{1}{4}$ times aa.

No clitellum was visible.

The male apertures are in segment xiii; there are to be seen two small whitish papillae, rather elongated transversely, their middle points somewhat above the line of the ventral setae, their lower margin about on a level with the setae. The setae are absent ventrally in this segment. There are no other genital marks.

It will be well to explain here that the numbering of the segments caused some difficulty. The position of the male pores so far forward as segment xiii is exceptional in the Geoscolecidae, and I at first assumed them to be on xv, a not unusual position, since I thought I counted fourteen segments in front of them. But on coming to examine the internal anatomy, this enumeration brought the testes to segments xii and xiii, the vesiculae seminales to xiv, and the ovaries to xv. The second specimen gave the same result, which appeared quite impossible. A renewed examination of the setae and of the segments at the anterior end of the animal showed that in front of the first seta-bearing segment there were two annuli without setae, separ-

[1] Two of my papers giving an account or a record of *L. socialis* reached Nomura while his paper "was in preparation for the press"; and since he recognized the identity of one of his species with mine, it seems a little perverse on his part,—even if he did not wish (as I believe is the proper course) to reject Hatai's name altogether,—to give that name to *L. socialis* rather than to the other, previously undescribed, species. He received *L. socialis* from Dr. Willey, from Ceylon (from whence one of my batches of material had been derived), and called *L. willeyi* the one which he did *not* receive from Dr. Willey.

ated by a rather shallow but quite visible groove, and both of fair extent, as shown in fig. 8. It is not very uncommon in earthworms to have one or a few segments at the anterior end without setae (in addition to the first, which of course is normally achaetous); but unless we are to suppose that the internal genital organs have an altogether anomalous position, that cannot be the case here; and we must, I think, suppose that the setae begin normally, i.e. on segment ii, the first segment being unusually long and biannulate,—even though this brings the male aperture into an anomalous position on segment xiii. This seems to me much easier than to suppose that the ovaries are in xv, and the male apparatus correspondingly displaced.

INTERNAL ANATOMY.

Septa 5/6 to 12/13 are somewhat thickened, decreasingly so towards the hinder end of the series; 6/7 is perhaps the stoutest.

I could discover no trace of a gizzard; the intestine begins in xii or xiii, but the beginning is indefinite, and there is nothing except the increasing investment of chloragogen to mark it off from the oesophagus. There are no calcareous glands.

The dorsal vessel is single, in the anterior part of the body at least. The lateral vessel, running longitudinally forwards on the body-wall from segment xiv, is conspicuous. The most peculiar feature of the vascular apparatus is the disposition of the hearts; whereas in most earthworms these closely embrace the alimentary tube, here they appear in the dissection as long loops which extend outwards onto the body-wall, reaching when the animal is pinned out to a position well beyond that of the dorsal setae and not very far from the middle line along which the animal was opened. Even when thus stretched out they are still much curled and twisted; so that in their natural position in the living worm they must form extremely convoluted loops. Being in the specimens almost empty of blood, they resembled nephridia at first sight; a closer inspection, and microscopic examination, revealed their true character. They occur in segments vii—xi, and decrease in size from behind forwards.

The nephridia are absent from the anterior part of the body, the most anterior being in segment xv; on one side of one of the dissected specimens there was a minute one in xiv. In each nephridium two parts can be seen; one a somewhat flattened, lobed, opaque white mass near the external end of the organ, the other a twisted tube extending inwards towards the middle line. The white masses are conspicuous structures in the dissection, and can be seen through the body-wall in the unopened worm. The ducts open to the exterior in the line of the ventral setae, just in front of the setae themselves.

The testes are in segments x and xi; they were relatively large in these specimens, and free in the body-cavity. Funnels were identified in both segments. The vesiculae seminales, represented in both specimens by a pair of transparent empty sacs, are situated in segment xii; in both specimens also the one on the left side is the larger.

What is perhaps a pair of "prostate" glands is present in segment xiii; each is a small and narrow white transversely elongated structure, resting on the body-wall throughout its length and attached at its inner end; they were situated nearer the posterior than the anterior limit of the segment, and occupied the middle of the interval between the lines of the dorsal and ventral setae,—their inner ends (as seen in the dissection, the lower in the natural condition) nearer to the line of the ventral setae than the outer ends to the dorsal setae; the inner end of each appeared to correspond in position to the centre of the male papilla.

The ovaries, large and conspicuous, are in segment xiii; funnels were doubtfully identified. Small ovisacs were present in xiv, depending from septum 13/14.

There were no spermathecae.

Remarks. The worms described above belong pretty obviously to the subfamily Criodrilinae of the Geoscolecidae, and within the subfamily approach nearest to the genus *Criodrilus* itself. *Criodrilus* however has a rudimentary gizzard, and the male pores open on segment xv. That the opening of the male pores on xiii in the present case is not an individual peculiarity is shown by the fact that both specimens manifest this character.

Since however the male pores are far more irregular in position in the Geoscolecidae than in other families,—there are a number of cases where worms are classed together in the same genus even though the male pores differ in position by more than two segments,—and since the rudimentary gizzard of *Criodrilus* is a matter of degree, I think the present species is rightly placed in that genus, to which it otherwise shows a close resemblance.

As will be seen from the above description, the specimens at my disposal were not fully mature.

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EXPLANATION OF PLATE IV.

FIG. 1.—*Kawamuria japonica*; dorsal and ventral setae. *a*, dorsal seta; *b*, tip of ventral seta.

,, 2.—The same; diagrammatic representation of penis and coelomic sac, to show general relations and to illustrate mode of action of sac.

,, 3.—The same; male genital organs, diagrammatic, reconstructed from sections.

,, 4.—The same; section passing obliquely through coelomic sac. × 115.

,, 5.—The same; section passing somewhat obliquely through lower end of coelomic sac and origin of penis; the penis is cut twice, and the section passes through the aperture of the male duct at the distal end of the penis. × 115.

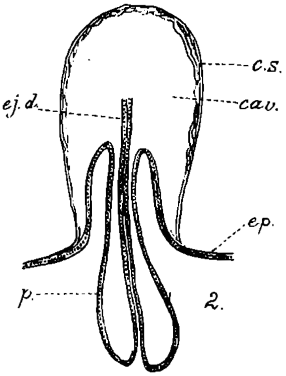
,, 6.—*Limnodrilus socialis*; part of a transverse section through middle of body, to show relative positions of dorsal vessel, ventral vessel, and ventral nerve cord. × 115.

,, 7.—The same; chitinous penial tube. × 115.

,, 8.—*Criodrilus bathybates*; anterior end.

FIGS. 4, 5, 6, and 7 drawn by means of Zeiss's Abbe's drawing apparatus.

at., atrium; *cav.*, cavity of coelomic sac; *chl.*, chloragogen cells; *c.m.*, circular muscular layer; *c.s.*, coelomic sac wall; *d.v.*, dorsal vessel; *ej. d.*, ejaculatory duct; *ep.*, surface epithelium; *f.*, male funnel; *l.m.*, longitudinal muscular layer; *p.*, penis; *pa.*, paratrium; *per.*, peritoneum; *pr.*, prostate; *s.*, septum; *v. def.*, vas deferens; *v.n.c.*, ventral nerve cord; *v.v.*, ventral vessel.



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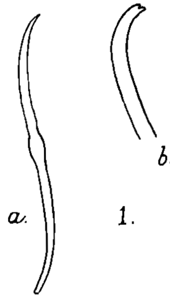

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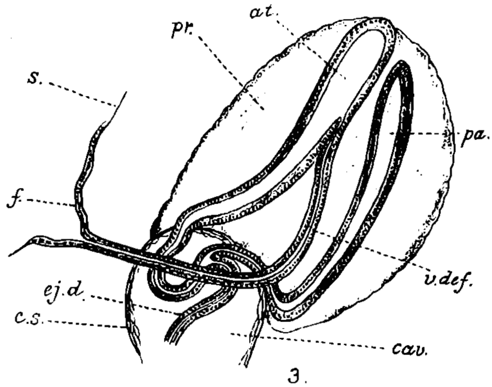

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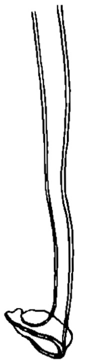

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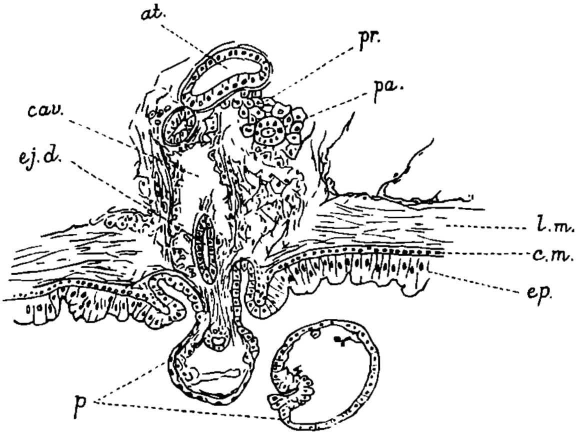

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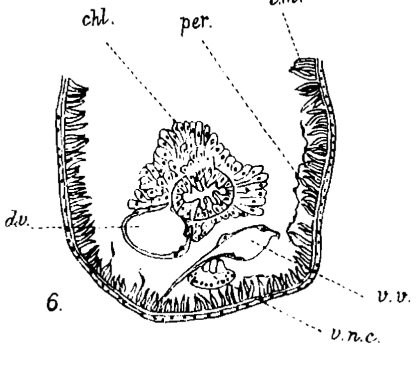

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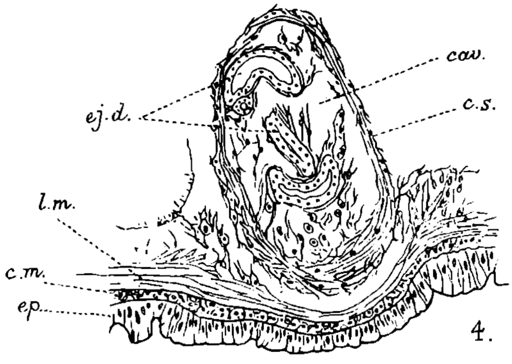

4.

AQUATIC OLIGOCHAETA FROM JAPAN.

A. Chowdhary, lith.

Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

HYDROZOA AND CTENOPHORA.

By N. ANNANDALE, *D.Sc.*, *F.A.S.B.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

HYDROZOA AND CTENOPHORA.

By N. ANNANDALE, *D.Sc.*, *F.A.S.B.* (*Zoological Survey of India*).

(With five figures in the Text.)

With the exception of one lacustrine species, the Hydrozoa discussed in this paper are from brackish water of variable salinity. The lacustrine form is *Cordylophora lacustris*, which was found in the Kiangsu Province of China. Four brackish-water species, all already known from other localities, are recorded from the Talé Sap on the Gulf of Siam (see map on p. 6 of this volume), and a new genus of medusae is described from the Gangetic delta.

The Hydrozoa from the Talé Sap are *Bimeria fluminalis*, Annandale, *Campanularia serrulata*, Bale, two unidentified medusae of the family Eucopidae, *Campanulina ceylonensis* (Browne) and *Liriope rosacea* (Eschscholtz). The first and third of these species occur also in creeks in the Gangetic delta and in the Chilka Lake on the east coast of India. In the Talé Sap the six species were found in water of a specific gravity (corrected to a standard temperature of 15°C.) of from 1·002 to 1·0085; but most of the medusae were apparently no more than occasional visitors from the sea, carried in and out of the mouth of the lake by the tide.

The only ctenophore in the collection is identical with the Ceylon race of the Malaysian *Pleurobrachia globosa*, Möser, of which another race (*bengalensis*, Annand. and Kemp) occurs both in the Chilka Lake and in the upper parts of the Bay of Bengal.

ORIENTAL HYDROZOA OF BRACKISH WATER.

The Coelenterata and Ctenophora of the Chilka Lake have recently been discussed in detail.[1] Those of the Talé Sap, a somewhat similar body of water, resemble them so far as the Hydrozoa are concerned, and it is probable that certain species will ultimately be found in most situations of the kind in different parts of the Indian Ocean. I take this opportunity, therefore, to consider briefly what we know of the

[1] Annandale, *Mem. Ind. Mus* V, pp. 65-118, pls. vi-ix (1915). There is not much literature on the Hydrozoa that occur in fresh and brackish water in the Oriental Region or the adjacent parts of Asia. References to freshwater forms in work published before 1911 will be found in my volume on the Freshwater Sponges, Hydroids and Polyzoa in the *Fauna of British India* (1911). Since that date *Limnocnida indica* has been discovered. It is described in vol. VII of the *Records of the Indian Museum* (pp. 253-256, figs. 1-2) Gravely and Agharkar have published notes on the species in the same journal (vol. VII, pp. 399-403, pl. xxxvi and vol. IX, pp. 247-249). So far as the brackish-water forms are concerned the most important recent publications are my report on the Coelenterata of the Chilka Lake, Ritchie's detailed description of *Annulella* from the Gangetic delta (*Rec. Ind. Mus.* XI, pp. 541-568, pls. xxx, xxx*a*; 1915) and Lloyd's account of the life-history and of the anatomy of the hydroid in *Campanulina ceylonensis*, *Rec. Ind. Mus.* XII, pp. 52-57, pls. v-vii, 1916). Full references to earlier memoirs will be found in the first of these papers.

Hydrozoa that inhabit brackish water in the Oriental Region; and to compare them with those forms that have established themselves in fresh water. By "inhabit" I mean, live out their full life-cycle. Medusae and hydroids attached to floating objects that are carried into the mouths of marine lakes or into the creeks of deltaic tracts by the tide and are able to survive for short periods in water of low salinity have not, in the present state of our knowledge, the same interest.

At present we know of only five hydroids and three hydromedusae that inhabit brackish water connected with the Indian Ocean.[1] They are:—

HYDROIDS.		MEDUSAE.
Annulella gemmata, Ritchie	?	=*Asenathia piscatoris*, nov.
Dicyclocoryne filamentata (Annand.)		=*D. filamentata* (Annand).
Bimeria fluminalis, Annand.		no medusa.
Campanularia serrulata (Bale)		no medusa.
Campanulina ceylonensis (Annand.)		=*Phortis ceylonensis* (Browne).

It will be as well to consider each of these species separately.

Evidence for the association of the medusa *Asenathia* with the polyp *Annulella* is still far from complete. The latter was originally introduced into an aquarium in Calcutta among weeds from small ponds of brackish water in which also it was subsequently found. These ponds are situated at Port Canning on the Mutlah (or Matla), a tidal river that formerly connected the Salt Lakes on the outskirts of Calcutta with the head of the Bay of Bengal, but now that the lakes have been to a large extent drained, forms merely part of the network of waterways covering the lower region of the Gangetic delta. The water both of the ponds and of the river is of low but extremely variable salinity, which is constantly changing in the latter with tide and season, and in the former owing to evaporation and rainfall. The organisms in the ponds have been introduced in floods from the river. Whether *Asenathia* and *Annulella*, therefore, are to be regarded as two species or as two generations of one species, they come from practically the same locality and live in similar circumstances. Neither has been found elsewhere.

In the case of *Dicyclocoryne*, another genus originally obtained from a pool of brackish water at Port Canning, the adult medusa is not known, but the young medusa has been described from specimens budded off in captivity. The species (the hydroid only) has also been found in the Chilka Lake, but the genus is as yet monotypic and apparently endemic in waters connected with the Bay of Bengal. It has not been found in the open sea.

Bimeria fluminalis is a species of a small but widely distributed marine genus perhaps not to be distinguished from the much larger genus *Perigonimus*, which is also marine. So far as we know, *B. fluminalis*, which has not been found in the open

[1] The only other Coelenterates that we know to inhabit brackish water in Eastern Asia are the Schizostomous medusa *Acromitus rabanchatu*, the Actiniaria *Edwardsia tinctrix*, *Halianthus limnicola*, *Metridium schillerianum*, *Phytocoetes gangeticus*, *Ph. chilkaeus*, *Pelocoetes exul* and *Gyrostoma glaucum*, and an unidentified Alcyonarian of the genus *Virgularia*.

sea, is the only representative of its genus that has become a true inhabitant of brackish water. In suitable localities on the shores of the Bay of Bengal and the Gulf of Siam it seems to have occupied the position in the estuarine fauna that is occupied in many temperate localities by the unrelated *Cordylophora lacustris*. Though capable, however, of living for some time in fresh water, it does not seem to have adopted the fluviatile and lacustrine habits of that species.

We do not know as yet anything definite about the life-history of *Campanularia serrulata*, which belongs to a universally distributed marine genus; I include it among the inhabitants of brackish water because I have found it reproducing its gonosome in an apparently healthy condition in water of low specific gravity. The species has evidently a wide range in the Pacific and Indian Oceans, but particulars are still lacking and there has been considerable confusion with species of allied genera in which the hydrophyton is very similar.

Campanulina is another marine genus of universal distribution. It probably includes many minute species that have up to the present escaped notice. The medusa of *C. ceylonensis* was first discovered in the open sea off Ceylon, but not far from the coast. The hydroid (which is very small, inconspicuous and difficult to preserve in a recognizable condition) has only been found as yet in brackish water, in the Gangetic delta and probably in the Talé Sap. The species is able to complete its full life-cycle in water of a specific gravity (corrected) of 1·0085, but apparently perishes if the specific gravity sinks much below 1·006.

Our knowledge of the fauna of tropical estuaries and marine lakes is still by far too incomplete to permit a detailed statement of the geographical affinities of any element in it. All that can be said in reference to the Hydrozoa is that in this group, as in the Polyzoa,[1] some widely distributed marine species are remarkably tolerant of low and even variable salinity, while others appear to have a strictly limited range in estuaries and marine lakes and to belong to small genera peculiar to definite areas.

From a biological point of view it is already possible to separate the Coelenterates of brackish water into two series, one merely tolerant, the other specialized to live in estuarine creeks and similar situations. Among the Oriental forms *Campanularia serrulata*, *Campanulina ceylonensis* and *Acromitus rabanchatu* belong to the former category; to the latter *Bimeria fluminalis*, the species and genera of Actiniaria referred to in a footnote on p. 104, and the abnormal hydrozoan genera *Annulella*, *Asenathia* and *Dicyclocoryne*. All the merely tolerant species, and a large proportion of those that have established themselves permanently in brackish water, represent cosmopolitan or at any rate widely distributed marine genera, and though specialized physiologically do not appear to be modified structurally. The three (or possibly only two) peculiar hydrozoan genera and the Actinian genera *Pelocoetes* and *Phytocoetes* are all highly modified structurally, and no one of them is known to have very near allies among true marine forms. They must, therefore, be

[1] Annandale *Mem. Ind. Mus.* V, pp. 119-133 (1915).

regarded as organisms that have been established in their present environment for a considerable period.

The only known species of *Annulella* is one of the small company of solitary hydroids. In many respects it is undoubtedly primitive, but this is not the case with its tentacles, the structure of which has induced Ritchie[1] to classify it provisionally in the subfamily Myriothelinae of the family Corynidae. If *Asenathia* represents the sexual generation of the same species this view will have to be modified, but evidence for the association is still far from complete. *Asenathia* is undoubtedly related to an imperfectly known genus (*Maeotias*, Ostrooumoff[2]) from the mouths of rivers entering the Sea of Azov; possibly it represents a group of Hydrozoa established at an ancient period in brackish water. *Dicyclocoryne*, though very distinct both in its hydroid and its medusoid generation from any other genus known, is a much more normal unit in the marine family Corynidae; while the two Actinian genera, though highly modified and quite distinct from one another, readily find a place in the subfamily Metridiinae of the family Sagartiidae; and to the same subfamily belongs the Gangetic estuarine species *Metridium schillerianum*, from which, indeed, both genera are possibly derived.[3]

In *Annulella* the chief point in which specialization can be definitely correlated with environment lies in the production of buds provided with a stout horny covering and therefore fitted to survive in circumstances that would kill the polyp. No form of specialization is more common than this among freshwater organisms; among the brackish-water animals of the Indian Ocean it is exemplified in the Polyzoon *Loxosomatoides*,[4] and in a still more striking manner in the sponge *Laxosuberites lacustris*,[6] which belongs to a marine genus and is not notably modified otherwise.

In *Asenathia* the most striking adaptive feature is the opacity of the bell. It is not quite clear what is the object of this modification but that it has some significance is indicated by the fact that a precisely similar type of colouration[6]—if colouration it can be called—is found among a number of fish and free-swimming crustacea that inhabit the silt-laden creeks and estuaries of the Gangetic delta, for example the Bombay Duck (*Harpedon nehereus*) among the fishes, *Leander styliferus*, *L. tenuipes*, and a remarkable new species of *Palemon* which will shortly be described in this volume by Mr. S. W. Kemp, among the prawns.

The essential generic characters of *Dicyclocoryne* are that the tentacles of the hydranth are all capitate and are regularly arranged in two circles and that the medusa, whose tentacles are also capitate, lacks ocelli. The only one of these characters that seems to be adaptive is the absence of ocelli; in many animals, from the Gangetic porpoise *Platanista* to this medusa, that live in the muddy waters of

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1 *Rec. Ind. Mus.* XI, pp. 543-568, pls. xxx, xxx*a* (1915).

2 *Zool. Anz.* XIX, p. 30 (1896). See p. 106, *postea*.

3 Annandale, *Mem. Ind. Mus.* V, pp. 73-75 (1915).

4 *Id.*, *ibid.*, p. 128.

6 *Op. cit.*, p. 45. The modification consists, in the case of this sponge, not in the mere production of bodies of the kind but in their high specialization.

6 See Kemp, *Rec. Ind. Mus.* XIII (*ined.*).

tropical estuaries and rivers, visual organs are degenerate or absent. A character of the hydrophyton that has much less systematic importance is thus described in *D. filamentata*,[1] "the colonies of this species often have a peculiarly lax appearance owing to the fact that the rhizome is adherent only in places and is sometimes produced into long filamentous free processes that bear terminal polyps. These, or rather the stalks from which they arise, may again become attached at their base to the object on which the colony is growing, so that loops of free rhizome are formed." A similar feature occurs in two distantly related Ctenostomatous Polyzoa[2] that live in the Gangetic delta, and is evidently a protection against overwhelming mud. The Polyzoa are *Victorella bengalensis* and *Bowerbankia caudata*.

We may now compare the Oriental Hydrozoa of brackish water with those that have established themselves completely in fresh water. Not more than five genera are yet known from any part of the world. They are *Hydra*, *Microhydra*, *Craspedacustes* (=*Limnocodium*), *Limnocnida* and *Polypodium*. The marine genus *Cordylophora* of the normal family Clavidae has at least one[3] species (*C. lacustris*, Allman) that is able to inhabit pure fresh water and has been found far inland, but this species seems to be essentially an inhabitant of estuaries and salt lakes and has probably been carried from sea to sea on the bottom of ships.

Hydra is a cosmopolitan genus consisting probably of three species,[4] *H. vulgaris*, Pallas,[5] *H. oligactis*, Pallas and *H. viridis*, Linné. These species are inhabitants of fresh water but are found rarely in brackish water. The only form really at home in the tropics seems to be *H. vulgaris*. There is no doubt that the genus is an extremely primitive one, and it seems improbable that it ever had a medusoid generation. The fertilized egg develops a horny coat which enables it in temperate regions to lie dormant through the winter, and through the summer in the tropics.

Only the polyp and the young medusa of *Microhydra* are known, and it is not absolutely certain that the adult medusa commonly assigned to *Limnocodium* is conspecific with the very *Microhydra*-like polyp from which it is believed, on circumstantial evidence, to originate. In any case it is doubtful whether *Microhydra* and *Craspedacustes* are generically distinct.[6] In both forms, if the commonly accepted identifications are correct, the medusa originates from a polyp without tentacles and only to a limited extent colonial and is remarkable chiefly for its very peculiar sense organs. It has a long and well developed manubrium and is not modified in any very obvious adaptive manner. *Microhydra ryderi*, Potts, has been found in rivers both in North America and in Europe, while *Craspedacustes sowerbyi*,[7] Lankester (the medusa and supposed polyp) were originally described from a lily-pond

[1] Annandale, *Mem. Ind. Mus.* V, p. 110 (1915).

[2] Annandale, *Mem. As. Soc. Bengal* VI, p. 25 (1916), and *Mem. Ind. Mus.* V, p. 125 (1915).

[3] I think it probable that *C. whiteleggei*, v. Lendenfeld, from Australia, is merely a dwarfed form of this species. See von Lendenfeld, *Zool. Jahrb.* II, p. 97, pl. vi, figs. 11-12 (1887).

[4] Annandale, *Faun. Brit. Ind. Freshw. Sponges*, etc., p. 147 (1911).

[5] The only species I saw in Japan was this one. There is a specimen from Lake Biwa in the Otsu Laboratory.

[6] See Potts, *Quart. Journ. Micr. Sci.* I, p. 623, pls. xxxv-xxxvi, and Browne, *ibid.*, p. 635, pl. xxxvii (1906).

[7] For literature previous to 1910 see Mayer's *Medusae of the World* II, pp. 363, 364; Douglas (*Zeits. wiss. Zool.* CII (1), pp. 92-110, pl. vi; 1912) has discussed origin and relationships more recently.

in a hot-house in England; the medusa has since been found at several places in Europe and in the United States in similar circumstances. A second closely related species or subspecies (*C. kawaii*, Oka[1]) has more recently been discovered living free in the Yangtse-Kiang; only the medusa is known.

The medusa *Limnocnida* seems to be of tropical origin; it has now been found in several of the great lakes of tropical Africa, in rivers in western Africa and Rhodesia, and in tributaries of the Kistna River in Peninsular India. Three species have been recognized, *L. tanganikae*, Günther, from the Central African lakes and the Niger, *L. rhodesiae*, Boulenger,[2] from tropical South Africa and *L. indica*, Annandale, from India. They are very closely related and may be no more than local races or subspecies. Nothing is known of an asexual generation, and the Central African medusa reproduces itself by budding as well as sexually, but there is strong circumstantial evidence, in the case of the Indian medusa at any rate,[3] that a fixed asexual generation occurs. The most striking feature of the medusa is the degenerate nature of its manubrium, but both Gravely and Agharkar (*op. cit.*) and Arnold and Boulenger[4] have shown that the mouth is capable of being closed, and does not in life remain widely gaping as was at one time believed to be the case.

Polypodium[5] is an extremely aberrant monotypic genus in which the life-cycle is complicated by parasitism (or at any rate semiparasitism), one stage living attached to the eggs of the Sterlet. No medusa is known, but one stage consists of a free-living polyp. The species is only known from the River Volga.

The true relationships of all these freshwater Coelenterates is still a matter of controversy. In none except *Hydra* has the full life-cycle been completely worked out, and it is not yet altogether clear to what extent *Polypodium* has been modified in accordance with its peculiar habits. It is not impossible that it may ultimately prove to be allied to *Annulella* and (?) even to *Maeotias*.

Craspedacustes and *Limnocnida* (including, for the sake of argument, *Microhydra* in the former genus) are among the most interesting of all freshwater organisms from the point of view of the student of geographical distribution and of the origin of the fauna of fresh water. The only localities where *Craspedacustes* has been found in natural circumstances are situated in the Holarctic Zone, and it is perhaps not without significance that the adult medusa from China was of a more robust habit than the one found in artificially-heated ponds. Mayer[6] suggests that the former may have been introduced into China in the cultivation of ornamental water-plants, but it is to say the least a curious coincidence that the aquatic worm *Branchiura sowerbyi* (Beddard), which was discovered at Kew in the same tank as *Craspedacustes*, also occurs in the Yangtse system. Stephenson[7] is of the opinion that this worm may

[1] *Annot. Zool. Jap.* VI, p. 219, pl. viii (1907).
[2] *Quart. Journ. Micr. Sci.* LVII, p. 427, pl. xlii (1912).
[3] Gravely and Agharkar, *Rec. Ind. Mus.* VII, p. 399 (1912).
[4] *Proc. Zool. Soc. London* 1915, p. 71. pl.
[5] The fullest account of this genus is given by Lipin in *Zool. Jahrb.* (*Anat. Abth.*) XXXI, pp. 317-426, pls. xi-xv (1911).
[6] *Medusae of the World* II, p. 366 (1910).
[7] *Mem. Asiat. Soc. Bengal* VI, p. 87 (1917).

be endemic in the Far East and, indeed, may have originated from a genus that lives in comparatively deep and therefore cold water in Japan. Browne[1] has shown that *Microhydra ryderi* and *Craspedacustes sowerbyi* can hardly be specifically identical, unless the organism has been profoundly modified by unnatural conditions of life; but it is improbable that any student of the hydroids would place the polyp from Kew in a different genus from the one originally described from Philadelphia and since rediscovered at Strassburg. There can be no doubt of the Holarctic origin of the latter species at any rate.

Limnocnida on the other hand has only been found in the tropics. The fact that it occurs on both sides of the Indian Ocean is noteworthy.[2] It is curious, furthermore, that in the Oriental Region the medusa has only been found in tributaries of the River Kistna or Krishna, in which also occurs the only Oriental representative of the molluscan family Aetheriidae,[3] a family that flourishes in the tropical parts of Africa and America.

What has been said will be sufficient to prove that the Hydrozoa of fresh water have no very close relationships either among themselves or with forms that have become established in brackish water. *Limnocnida* is perhaps remotely related to *Craspedacustes* and the latter probably belongs to the same subfamily as *Asenathia*; but the different genera undoubtedly represent different attempts made, sometimes successfully, at different places and at different epochs to colonize fresh water on the part of marine organisms, all of which have either become modified in the course of their progress inland, or else have chanced to become modified in the sea in such a way as to have been rendered fitter thereby for life in rivers or lakes and thus have been enabled to migrate inland. No common line of evolution has been followed, and the structural modifications that have been brought about do not seem to be correlated with changes in the specific gravity or chemical constitution of the medium in which the animals live; adaptation for this purpose has been physiological rather than structural. Hargitt[4] has shown that the pulsation of the bell of *Craspedacustes*, though active in ordinary fresh water, cease in distilled water. I have myself shown that a precisely similar result follows in the case of the Schizostomous medusa *Acromitus* if the salinity is reduced below a certain limit.[5] Thus two medusae not in any way related to one another, both of which have become adapted to live in water of lower salinity and specific gravity than that of the open sea, are affected in a similar manner by changes in the composition of the medium in which they live, but the one that has established the fluviatile habit completely is no longer affected by a change that produces complete paralysis in the other, which inhabits both the open sea and lagoons of brackish water. Neither of these species is obviously adapted anatomically, so far as our present knowledge goes, to withstand permanent or temporary changes in the chemistry of its environment. In all fresh-

[1] *Quart. Journ. Micr. Sci.* L, p. 638 (1906).
[2] Annandale, IV *Congrès Internat. Zool., Monaco* 1913, Sec. VI, p. 581 (1914).
[3] *Mulleria dalyi*, Smith, *Proc. Mal. Soc. London* III, p. 13 (1898). See also Woodward, *ibid.*, p. 87.
[4] *Biol. Bull. Washington* XIV, p. 304 (*fide* Mayer).
[5] *Mem. Ind. Mus.* V, p. 101 (1915).

and brackish-water Coelenterates structural modifications can be discovered, and in some cases these modifications can be definitely correlated with unfavourable circumstances, such as silt in suspension or deposited or the danger of a sudden change in conditions of life; but in none can we yet say that this or that character is an adaptation for life in water of low or variable salinity. So far as this element in the changed conditions is concerned, the physiological evolution involved in the change of habitat has been much more comprehensive than the anatomical. The only features of a general kind that all the genera and species have in common are negative—a small size and lack of brilliant or conspicuous pigments; even convergence is not indicated.

SYSTEMATIC DESCRIPTION OF THE COLLECTION.

HYDROZOA.

Order *GYMNOBLASTEA*.

Family CLAVIDAE.

Genus **Cordylophora**, Allman.

This genus, which for long was regarded as monotypic and as essentially fluviatile and lacustrine, is now known[1] to include several marine species.

Cordylophora lacustris, Allman.

1868. *Crodylophora lacustris*, Hincks, *Brit. Hydr. Zooph.*, p. 16, pl. liii, fig. 2.
1871. *Cordylophora lacustris*, Allman, *Mon. Gymn. Hyrd.*, p. 252, pl. iii.
?1887. *Cordylophora whiteleggei*, v. Lendenfeld, *Zool. Jahrb.* II. p. 97, pl. vi, figs. 11-12.

I find among my collections from the Tai-Hu (Great Lake) in the Kiangsu Province of China several Hydroid colonies that agree in every respect, so far as the hydrophyton is concerned, with examples of *Cordylophora lacustris* from England, Germany and Egypt. Unfortunately none of them bear gonosomes. The largest colonies are about 3 cm. long. They were attached with the polyzoon *Paludicella elongata*[2] to mussel-shells (*Modiola lacustris*, v. Martens), which in their turn were fixed to the roots of willow-trees. The Tai-Hu is an inland freshwater lake connected by numerous creeks with the Yangtse system, but not by any main waterway; a sketch map is reproduced on p. 4 of this volume.

So far as I am aware, *C. lacustris* has not previously been recorded from the Far East. It occurs in fresh and brackish water in many parts of Europe, N. America and western Asia, and has been found in the almost land-locked Sea of Azov[3] and the now isolated salt-lake Birket-el-Qurun,[4] which was formerly connected with the Nile. The Australian form *C. whiteleggei*, v. Lendenfeld is perhaps no more than a dwarfed

[1] Motz-Kossowska, *Arch. Zool. expérim.* (4) III, pp. 63-67 (1905).
[2] Annandale, *Mem. As. Soc. Bengal* VI, p. 30 (1916).
[3] Ostrooumoff, *Bull. Ac. Imp. Sci. St. Pétersbourg* (5) IV, p. 400 (1896).
[4] C. L. Boulenger, *Quart. Journ. Micr. Sci.* LII, p. 358 (1908).

race, but its gonosome has not been examined. I have seen an imperfect specimen embedded in a colony of the Polyzoon *Australella lendenfeldi*[1] (Ridley) from New South Wales.

Family BOUGAINVILLIIDAE.

Genus **Bimeria**, Wright.

Bimeria fluminalis, Annandale.

1915. *Bimeria fluminalis*, Annandale, *Mem. Ind. Mus.* V, pp. 111, 112, fig. 10, pl. lix, figs. 3, 3*a*.

Fishing-stakes in the outer lake of the Talé Sap were covered with this hydroid in January, 1916. I also dredged a small stick similarly covered in the connecting channel between the outer and the inner lake. The specific gravity of the water (corrected) varied from 1·0015 to 1·004.

FIG. 1.—*Bimeria fluminalis*.

Part of a colony from a fishing-stake in the outer part of the Talé Sap. × 2.

Siamese specimens do not differ materially from Indian ones so far as the structure of the hyrdophyton and gonosomes are concerned, but the chitinous investment of the base of the tentacles is thinner and less easy to detect. I was led, therefore, to believe at first that those from the Talé Sap represented a species of *Perigonimus* and not the true *B. fluminalis*. In any case the separation between the two genera, if we regard *Wrightia* as synonymous with *Perigonimus*, is so slight, depending as it does upon this variable character of the investment of the hydranth, that it may have to be abandoned.[2] I leave the question to those who have a wider knowledge of the marine hydroids.

B. fluminalis is only known from brackish and temporarily fresh water connected with the Bay of Bengal and the Gulf of Siam.

Order *CALYPTOBLASTEA*.

Family CAMPANULARIIDAE.

Genus **Campanularia**, Lamarck.

Campanularia serrulata, Bale.

1889. *Campanularia? serrulata*, Bale, *Proc. Linn. Soc. N.S. Wales* III (1), p. 757, pl. xii, fig. 4.

I found a Campanulariid hydroid in the Talé Sap which on a superficial examination I mistook for the species from the Chilka Lake that I recently identified as *Clytia serrulata*.[3] A closer scrutiny, however, revealed the fact that it was a true *Campanularia*, and yet that it agreed even more closely with Bale's original figure than

[1] Annandale, *Rec. Ind. Mus.* XI, p. 167 (1915).

[2] Motz-Kossowska, *op. cit.*, pp. 69, 70 (1905).

[3] Annandale, *Mem. Ind. Mus.* V, p. 106, pl. ix, figs. 1, 1*a*, 1*b* (1915).

the Indian specimens, which certainly represent a *Clytia*. There are thus three candidates for the name of Bale's species, which was described without reference to the gonosomes and was therefore generically unidentifiable. They are *Obelia serrulata*, Thornely,[1] *Clytia serrulata*, Annandale, and the present form. Furthermore, Borradaile,[2] recognizing that Miss Thornely's identification was incorrect, has renamed *her* species *Campanularia serrulatella*. It is perhaps best to say no more. I figure a hydranth in its theca and a gonotheca from one of my Siamese specimens; the essential characters of the species lie in these structures.

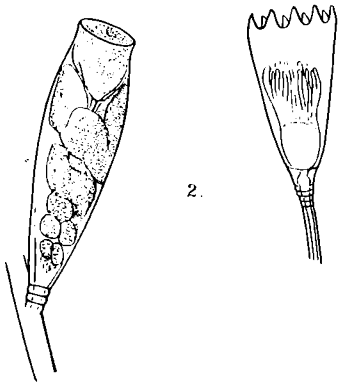

FIG. 2.—*Campanularia serrulata*.
Hydrotheca with hydranth and gonotheca of a specimen from the outer channel of the Talé Sap. × 30.

In January, 1916 this form was abundant on shells, sticks and dead palm-leaves in the outer channel of the Talé Sap and between Kaw Yaw and the main land. The colonies have numerous gonothecae containing ripe gonosomes. They were living in water of very variable salinity, its specific gravity (corrected) being from 1·004 to 1·0085.

Bale's species was described from New South Wales (Port Jackson) and was growing on a *Plumularia*.

Two species of medusa belonging to the family Eucopidae were not uncommon, with *Liriope rosacea*, in the channels of the outer lake of the Talé Sap in January, 1916. They were, however, not true inhabitants but were carried in from the sea by the tide. My specimens are now in poor condition and were probably degenerate when captured; I prefer not to attempt to identify them.

Family CAMPANULINIDAE.

Genus **Campanulina**, van Beneden.

Campanulina ceylonensis (Browne).

HYDROID.

1906. *Irene ceylonensis*, Annandale, *Rec. Ind. Mus.* I, p. 142, fig. 4.
1916. *Campanulina ceylonensis*, Lloyd and Annandale, *ibid.* XII, pp. 49-57, fig. 1, pls. v-vii.

MEDUSA.

1905. *Irene ceylonensis* and *I. palkensis*, Browne in Herdman's *Rep. Ceylon Pearl Fish.* VI, pl. iii, figs. 12-16.
1907. *Irene ceylonensis*, Annandale, *Journ. As. Soc. Bengal* (n.s.), p. 79, pl. ii, fig. 5.
1910. *Phortis palkensis* and *P. ceylonensis*, Mayer, *Medusae of the World* II, p. 309.
1915. *Campanulina ceylonensis*, Annandale, *Mem. Ind. Mus.* V, p. 104.

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[1] In Willey's *Zool. Results* IV, p. 453, pl. xliv, fig. 5 (1902).
[2] In Gardiner's *Faun. Geogr. Results Laccadive and Maldive Arch.* II, p. 839.

The medusa of this species was abundant in the outer channel of the Talé Sap, with *Liriope rosacea*, in January 1916, and badly preserved colonies of a minute hydroid that is probably of the same species were found on the stems of colonies of *Bimeria* from off Koh Yaw when the latter were examined in Calcutta. Many of the medusae were sexually mature.

The medusa and hydroid appeared again in July, 1916 in the canal at Calcutta in which they were found in 1915 (see Lloyd and Annandale, 1916). Fuller inquiries seem to indicate that they do so about the same time every year, shortly after the opening of certain locks that allow water from the outer canal system connected with the Mutlah River, and so with the sea, to enter. They disappear as the water becomes fresh or nearly fresh with the fall of the rains, being apparently unable to live in water below or much below 1·006 in specific gravity (corrected to a standard temperature of 15°C).

The species is evidently common in the Bay of Bengal, round the coasts of Ceylon and in the Gulf of Siam.

Order *TRACHYMEDUSAE*.

Family OLINDIADIDAE.

1910. Olindiadae, Mayer, *Medusae of the World* II, p. 340.

Subfamily PETASINAE.

1910. Petasinae, Mayer, *op. cit.*, p. 361.

As it seems to be impossible to recognize any species of *Petasus*, the name of the subfamily may have to be changed, but its limits are at present so uncertain that it is best to regard it as a provisional group for which the name adopted in Mayer's standard work on the medusae may be used conveniently.

The genera included provisionally are *Petasus* (?), *Aglauropsis*, *Craspedacustes* (=*Limnacodium*), *Microhydra*, *Gossea*, *Maeotias* and the new genus here described under the name *Asenathia*. It is not improbable, however, that *Craspedacustes* and *Microhydra* are generically identical, while *Asenathia* may be the medusoid generation of the hydroid *Annulella*, whose name in that case has clear priority. *Petasus*, *Aglauropsis* (which is still known but imperfectly in the adult state) and *Gossea* are marine genera, the development of which is quite unknown, and *Gossea*, the only one of the three of which the generic diagnosis is satisfactorily established, differs very considerably in general facies and in the arrangement of its tentacles from *Craspedacustes*, the medusa of *Microhydra*, *Maeotias* or *Asenathia*. These four genera live in fresh or brackish water.

The new genus is nearer to *Maeotias*[1] than to any other, but differs in the structure of its gonads and sense-organs, so far as it is possible to base a dogmatic statement on the brief and incomplete description supplied by the author of *Maeotias*.

[1] Ostroumoff, *Zool. Anz.* XIX, p. 30 (1896) and *Bull. Acad. Imp. Sci. St. Pétersbourg* (5) IV, p. 402, pl. i, figs. 1, 3 (1896) (in Russian).

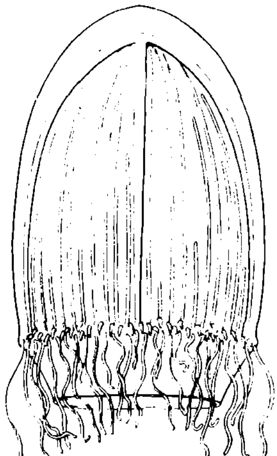
Asenathia, gen nov.

I propose this new genus for the reception of a small medusa from creeks and estuaries in the neighbourhood of Port Canning in the Gangetic delta. It may be defined as follows:—

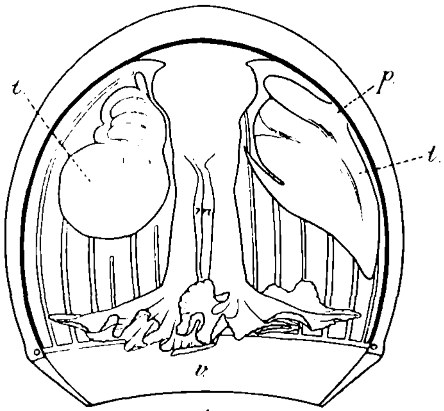
> Petasine medusae with numerous hollow tentacles not arranged in groups, without a manubrial peduncle, with free marginal lithocyst-clubs but without marginal processes, with 4 radial and numerous centripetal canals, 4 sac-like gonads and 4 manubrial lips.

Type-species. *Asenathia piscatoris*, sp. nov.

The new genus appears, as already stated, to be closely related to *Maeotias*, Ostrooumoff, from the Azov estuaries, but to differ in its open sense-organs and in the absence of marginal processes. The original description of the unique species of *Maeotias* is, however, very brief and the figure published later, with a full description in Russian, imperfect.



3.



4.

FIGS. 3, 4.—*Asenathia piscatoris*, sp. nov.

FIG. 3.—Type-specimen, × 5. FIG. 4.—An adult male specimen with half of the bell removed, × 5. *m* = manubrium. *p* = peduncle of gonad. *t* = testis. *v* = velum. The tentacles are not more shown in fig. 4.

Asenathia piscatoris, sp. nov.

The species consists, so far as we know at present, of small medusae remarkable for the opacity of their bell and for their conical or half egg-shaped form. In the largest specimen examined (a mature male) the height of the bell is 13 mm. and the transverse diameter at the base 1·3 mm., but it seems to be in a contracted condition, and the other two examples as yet captured are much more elongate and distinctly narrower than high. These two specimens, one of which is figured, are smaller than the first and their gonads are not quite ripe. The jelly of the bell is rather thin.

The velum is very broad and, in the two expanded specimens, hangs down vertically. It was noted in this position in two living medusae, which had, however, both been injured in the net.

No pigment can be detected in any part. The bell is of a dead milky white, translucent but not at all transparent. In the living medusa it was if anything more opaque than it is in specimens preserved in formalin. The gonads, the tentacles and the upper part of the manubrium are less translucent than the remainder of the organism.

The four radial canals are of moderate breadth. Between each two of them there are about 10 centripetal canals, some of which reach upwards almost to the base of the stomach, while others are quite short. Neither the number nor the arrangement of these canals is constant even in the different radii of the same medusa, but as a rule long and short canals alternate.

The gonads, in the male, are lamelliform and slightly folded in an irregular manner. They are attached below the radial canals near the base of the stomach by short peduncles and when ripe hang down as free structures at least half way to the velum. In this condition they are bulky and probably influence the shape of the bell.

The manubrium is highly contractile but can be extended as far down as the mouth of the bell. It is stout even when extended so far. The stomach is bulky and extends for about half the length of the manubrium when the latter is contracted. The lips are very broad and much folded; each is pointed at the tip. Their margin is minutely crenate.

The tentacles are very numerous, the normal number being at least 200. They are simple hollow structures, without basal bulbs or adhesive pads. The distal part of each is long and filiform, but is very readily broken off. When this occurs the basal part persists as a finger-shaped process the tip of which is sometimes a little introverted. On the distal part there are simple rings of nematocysts, which are directed outwards but by no means prominent. The tentacles have a definite arrangement, though it is liable to numerous minor irregularities. It is as follows:—near the base of each vertical canal, whether radial or centripetal, a large tentacle arises in the jelly of the bell and arches downwards; between each pair of tentacles of this cycle three others, similar but slightly smaller, also arise in the jelly, and below these again, close to the margin, an indefinite number of much more slender tentacles are affixed to the surface.

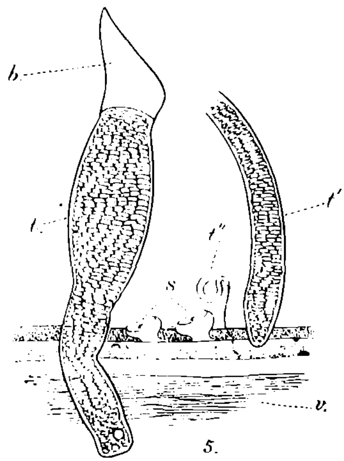


FIG. 5.—*Asenathia piscatoris*, sp. nov.

A minute portion of the margin of the bell showing one tentacle of each of the three circles, sense-organs, etc., × 50.

The two larger tentacles are incomplete and only the upper part of the velum is shown.

b = base of tentacle buried in the jelly. t = tentacle of upper circle. t = tentacle of middle circle. t = tentacle of lowest circle. s = sense organ. v = base of velum.

The sense-organs are minute and difficult to distinguish as they are completely concealed by the tentacles. They are arranged, sometimes in pairs, on the nerve-ring and seem to be numerous. Each has the form of a bowl or trumpet containing a single concretion in its hollow. To elucidate their structure completely sections would be necessary.

The nematocysts are almost spherical. They are from 7 to 9μ long and about 6μ broad.

Locality. Tidal creeks containing water of low but extremely variable salinity in the neighbourhood of Port Canning, Gangetic delta. Three specimens were taken by Mr. Stanley Kemp and myself in December 1916, one in a townet on the surface, the other two in a bottom-net. One of the latter was the only fully mature specimen seen (fig. 4, p. 114).

Type-specimen. No. ZEV. $\frac{7246}{7}$, *Zool. Survey of India.*

It seems to me by no means improbable that this medusa is the sexual generation of *Annulella gemmata*, Ritchie, but the only morphological evidence lies in the close resemblance of its nematocysts to the larger nematocysts of the hydroid.

Family GERYONIDAE.

Genus **Liriope**, Lesson.

Liriope rosacea (Eschsch.).

1897. *Liriope rosacea*, Maas, *Mem. Mus. Zool. Harvard* XXIII (1), pp. 25, 26, pl. iii, figs. 7-8.
1910. *Liriope rosacea* Mayer, *Medusae of the World* II, pp. 416, 417, figs. 269, 270, 273, pl. iii, fig. 1.

Young medusae of this species were abundant in the channels of the outer lake of the Talé Sap in January, 1916. The oldest were not much more than 10 mm. in diameter, and were in the stage figured by Maas in 1897. Others were smaller and had the manubrium quite short, as in the immature stages of *Liriope* sp., figured by Mayer (*op. cit.*, 1910, pl. 1, figs. 1 and 2).

These little medusae were carried in and out of the lake by the tide and probably had been bred in the sea. They cannot be regarded as more than casual visitors to the lake-system.

L. rosacea has a wide distribution in the littoral zone of the warmer seas.

CTENOPHORA.

Order *CYDIPPIDEA*.

Family PLEUROBRACHIDAE.

Genus **Pleurobrachia**, Flemming.

Pleurobrachia globosa ceylonensis, Browne.

1915. *Pleurobrachia globosa* var. *ceylonensis*, Browne in Herdman's *Rep. Ceylon Pearl Fish.* IV, p. 161.

A ctenophore that answers well with Browne's description was common in the outer part of the Talé Sap in January, 1916, in water of a specific gravity (corrected) of from 1·0062 to 1·0085.

This form is intermediate between the *forma typica* of the species[1] from the Malay Archipelago and the race[2] that occurs in the upper part of the Bay of Bengal; it has been known hitherto only from the coast of Ceylon.

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[1] Moser, *Ctenophoren Siboga-Exp.* (mon. XII), p. 7, pl. i. figs. 1-4 (1903).

[2] Race *bengalensis*, Annandale and Kemp, *Mem. Ind. Mus.* V, p. 118, pl. ix, fig. 5 (1915).

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ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

BATRACHIA.

By N. Annandale, *D.Sc.*, *F.A.S.B.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

BATRACHIA.

By N. ANNANDALE, *D.Sc.*, *F.A.S.B.* (*Zoological Survey of India*).

This paper is a batrachiological miscellany, founded only in part on the results of my tour in the Far East but treating solely of species from eastern Asia. I have taken the opportunity to discuss a number of Indian frogs of the genus *Rana* about which confusion exists in literature or in collections and to describe or annotate certain tadpoles from Burma, Ceylon and other countries that lie east of the Bay of Bengal.

No effort was made on my tour to obtain a general collection of Batrachia and, indeed, few localities were visited that would have been likely to yield specimens interesting in themselves. From a geographical point of view, therefore, the only district on which my results cast a definite light is that immediately round the Talé Sap in the Siamese Province of Sunkla or Singgora. This lake is connected with the Gulf of Siam and lies in the north-eastern part of the Malay Peninsula; except for small rocky islands and groups of low hills, the shores are flat and devoid of thick jungle. The frogs and toads are, therefore, lowland species widely distributed in open country. The following species are represented in my collection from this district:—

SPECIES FROM THE SHORES OF THE TALÉ SAP.

Oxyglossus lima (Gravenh.),	*Microhyla ornata* (D. and B.),
Oxyglossus laevis, Günther,	*Microhyla achatina* (Boie),
Rana cancrivora, Gravenh.,	*Kaloula pulchra*, Gray,
Rana cyanophlyctis, Schneid.,	*Bufo melanostictus*, Schneid.

The most interesting of these species geographically are *R. cancrivora* (an essentially Malayan frog accompanied in continental Siam by the allied, but not very closely allied, *R. rugulosa*) and *R. cyanophlyctis*, the precise geographical distribution of which outside India (in which it is universally distributed at low elevations) is still very imperfectly known. The only previous record of the latter from the Malay Peninsula depends on specimens from Cantor's collection—a notoriously corrupt source—labelled as being from Penang.

FROGS OF THE RANA TIGRINA GROUP.

Under this heading I propose to consider three forms that seem to me to be distinct species; they have been confounded under the name *Rana tigrina* by recent herpetologists. They are *Rana tigrina*, Daudin, *R. rugulosa*, Wiegman and *R.*

cancrivora, Gravenhorst. The difficulty about them lies largely in the fact that poorly preserved examples are much less easy to distinguish than living or recently killed specimens. No one could confuse living frogs of the form I call *R. cancrivora* with the true *Rana tigrina* of India, but if specimens have become sodden and discoloured it is very difficult to distinguish between them. Indeed, the only really satisfactorily preserved specimens that I have seen are those that have been hardened in fairly strong formalin and then transferred to alcohol, each specimen having been killed and kept until hard in a separate bottle or tin of comparatively large size. However, the notes that Dr. Boulenger and Dr. van Kampen have been kind enough to send me prove that with a practised eye it is possible to distinguish even specimens preserved with much less care.

Daudin's original figure of *R. tigrina* was evidently drawn from a frog that had been distorted by pressure and had become discoloured, but it shows the characteristic shape of the snout and the fully webbed, coarse toes of the species. The figure reproduced in Boulenger's volumes in the *Fauna of India* and the *Fauna of the Malay Peninsula* is an admirable likeness of this frog.

No satisfactory figure of *Rana cancrivora* has hitherto been published, but Wiegmann's original figure of *R. rugulosa* is good.

The three species may be distinguished as follows:—

I. Feet almost fully webbed, the web extending at least as far as the base of the terminal phalanx of each toe, and being very little emarginate.
    A. Snout distinctly pointed; ventral surface immaculate or practically so .. .. *R. tigrina.*
    B. Snout rounded; ventral surface, or at any rate the throat, spotted or reticulated with black .. .. *R. rugulosa.*

II. Web of feet distinctly emarginate between the toes, not reaching the base of the terminal phalanx of the fifth toe.
    Snout rounded; ventral surface, or at any rate the throat, blotched or marbled with brown; a white spot often present at the proximal end of the external metatarsal fold .. .. .. *R. cancrivora.*

These characters are best seen in fully adult frogs that have not yet attained old age. The colouration of the young *Rana tigrina* is quite distinctive.

Rana tigrina, Daudin.

(Plate V, figs. 1-2, pl. VI, figs. 1, 1*a*).

1803. *Rana tigrina*, Daudin, *Hist. Ran.*, p. 64, pl. xx.
1882. *Rana tigrina*, Boulenger, *Cat. Batr. Sal. B.M.*, pp. 22-27 (in part).
1890. *Rana tigrina*, *id.*, *Faun. Brit. Ind.*, *Rept.*, pp. 449, 450 (in part), fig. 132.
1915. *Rana tigrina*, Nicholls, *Proc. Zool. Soc. London*, II, pp. 603-609.

LARVA.

1904. *Rana tigrina*, Ferguson, *Journ. Bom. Nat. Hist. Soc.*, XV, p. 501.

In fresh specimens of *R. tigrina* (*s.s.*) the habit is rather slender than stout but moderate rather than extreme in either direction. The head (measured from the posterior border of the tympanum to the tip of the snout) is at least as long as it is broad at the base, except in some very old individuals. The head is considerably narrower in the young frog. The outline of the two sides of the head as seen from above is gradually convergent and practically straight as far as the nostril; from the nostril to the tip of the snout it converges much more rapidly and is somewhat convex, but the snout has the appearance of being pointed not very sharply. In profile the outline of the head slopes gradually and regularly forwards from the eye to the nostril and thence more abruptly downwards at an angle of about half a right angle with the vertical. The upper jaw projects far beyond the lower. The eyes are very large and prominent.

The vocal sacs of the male are external and large, having a spherical form when inflated. They are situated on either side of the throat close to the gape.

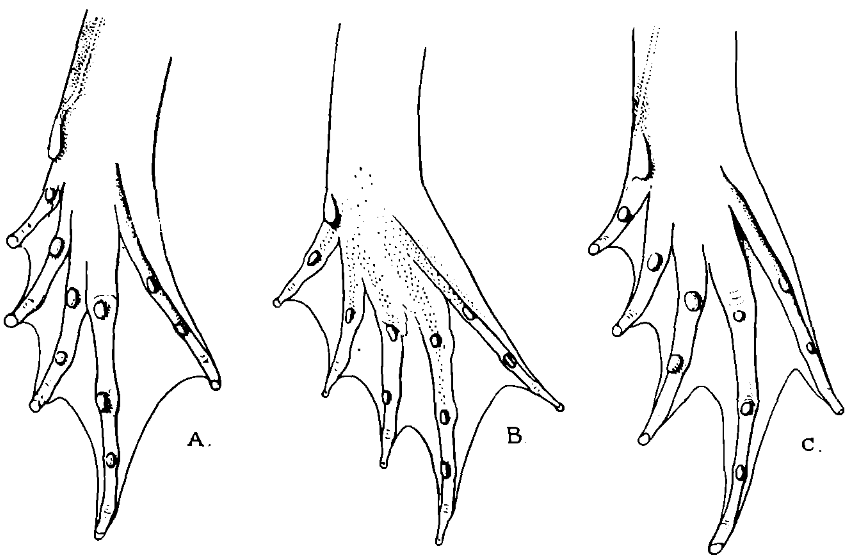

FIG. 1.—Feet of frogs of the *Rana tigrina* group.

A.—*R. tigrina*. B.—*R. rugulosa*. C.—*R. cancrivora*.

The vomerine teeth are very prominent and extend in two long oblique series from the inner front edges of the choanae.

The dorsal surface of the body bears numerous longitudinal folds, which are never cotinuous for its whole, or even for half its length. Scattered among them on the posterior part of the back there are often small circular warts and granules, but these never extend as far forwards as the back of the head. The sides are more or less warty and the ventral surface smooth.

The hind limbs are slender and moderately long, the tibia being about half as long as the head and body. The feet are broad and the toes coarse, rather blunt but not at all dilated at the tips. The third toe does not reach the distal subarticular tubercle of the fourth. There is a well-developed external metatarsal fold but no trace of an external metatarsal tubercle. The web of the foot is practically complete, extending at least as far as the base of the terminal phalanx in all the digits. When the foot is stretched out the margin of the web is slightly convex between the fourth and fifth toes. The internal metatarsal tubercle varies greatly in size and shape but the variation seems to be individual rather than racial, for extremes, which are not correlated with other differences, occur at many or all points in the geographical range of the species.

The skeleton of *R. tigrina* has recently been described by Nicholls. I have been able to confirm his observations on most of the bones by an independent examination.

The colouration of the living frog is characteristic, especially in the young, for

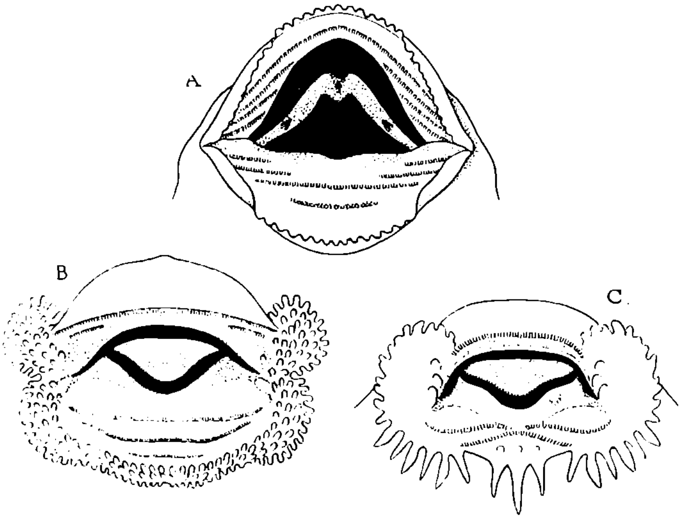

FIG. 2.—Mouth-disc of tadpoles of the *R. tigrina* and *R. limnocharis* groups.
A.—*R. tigrina* (× 14). B.—*R. limnocharis* (× 18). C.—? *R. brevipalmata* (× 10).

in the adult some of the distinctive markings become obscure. The dorsal surface is green in the male and yellowish in the female, the sexual differences appearing at an early age. In the young of both sexes a black bar extends forwards from the eye through the lower edge of the nostril to near the tip of the nostril, but the bars of the two sides do not quite meet. Below this bar there is a broader and usually somewhat irregular white stripe extending below the eye from the tympanum to the end of the snout, and below this again the edge of the upper lip is white, sometimes with irregular vertical black bars. The lower lip is white with rather broad, scattered black bars. All these markings tend to disappear in preserved adult specimens, though they can usually be traced even in large fresh specimens. A pale mid-dorsal stripe is usually, but not always present and has a much more permanent character. Large blackish spots, often with a dead black margin, and surrounded by a faint pale halo at any rate on the posterior regions, are scattered over the whole of the dorsal surface except on the head, and the backs of the thighs are marbled The ventral surface is usually immaculate, but sometimes there is a large black spot on either side of the chest just in front of the fore limbs and the throat of the adult (especially in the male) is often slightly clouded with black.

The head and body of full-grown frogs are together about 120 to 135 mm. long, about $\frac{1}{3}$ of the total length being occupied by the head.

The larva of *R. tigrina* has been referred to by Ferguson but has not as yet been adequately described, the tadpole assigned to the species by Flower being really that of *R. rugulosa*. The body is oval, about $1\frac{1}{2}$ times as long as broad, about $\frac{2}{3}$ as long as the tail, and distinctly depressed, both the dorsal and ventral surfaces being somewhat flattened. The eye is dorsal in position, small and by no means prominent. It is situated at about $\frac{2}{3}$ the distance between the base of the hind limb and the tip of the snout. The nostrils are situated close together on the dorsal surface, a little nearer the eyes than the tip of the snout. The mouth is subterminal; its disc closely resembles that of *R. rugulosa*, the dental formula being 1 : 4+4/3+3 : 1 or 1 : 3+3/3+3 : 1. Both parts of the beak are very stout and of a dense black colour. The upper mandible bears a strongly pointed projection in the middle, which fits into an excavation between two similar projections on the lower mandible. There is a heartshaped horny pad on the roof of the mouth and a conical projection tipped with horn at the base of the lower jaw inside the mouth on each side. The tail is narrowly and regularly lanceolate, the upper and lower profile being almost symmetrical. The upper membrane does not extend forwards on the body. The colouration of the tadpole is never conspicuous but varies considerably in different surroundings. The back is darker than the sides and usually bears a Y-shaped dark mark, the divergent lines extending backwards from the eyes. There is also a small black spot or crescent behind each nostril. The ventral surface is whitish, somewhat iridescent on its posterior half. The tail is speckled greyish. The size varies greatly in correlation with nutrition, etc.

Geographical Distribution.—The true *R. tigrina*, originally described from Bengal, occurs all over the plains of India proper, Assam, Lower Burma and Ceylon. In Upper Burma it is apparently rare, but specimens are found as far east as the Chinese province of Yunnan. On the eastern side of the Bay of Bengal I have seen no specimens from further south than Tavoy. The species avoids hilly country. It is essentially a pond frog but in districts where there is a distinct dry season aestivates or hibernates in holes in the ground. The tadpole is found in pools and ponds.

The following is a list of the adult specimens in the Indian Museum :—

9227	Sind	Karachi Mus. (Ex.).
9041	Rajanpur	C. Sanders.
9025	Agra, U.P.	Agra Mus. (Ex.).
15866-69	Sundrijal and Katmandu, Nepal	R. A. Hodgart.
16457	Sukna, base of E. Himalayas	Mus. Collr.

15719–20	Sara Ghat, E. Bengal	R. A. Hodgart.
16458	Dumukdia Ghat, E. Bengal	Mus. Collr.
15961	Khoolna, E. Bengal	J. Caunter.
5576–77	Nattore, Rajshahi	T. R. Doucett.
16456–7	Pusa	C. Paiva.
8999: 9000–3: 9028: 9030–1: 9042–43: 9046:	Calcutta	J. Anderson.
18173–77	Ballygunj, Calcutta	R. Hodgart.
9049: 9007	Botanical Gardens, Sibpur, nr. Calcutta	J. Anderson.
12572	Chandbally, Orissa	C. H. Dreyer.
9067	Godaveri Valley	W. T. Blanford.
18221–23	Nova Goa, Portuguese India	Capt. F. deMello.
18224–45	Marmagoa, ,, ,,	S. W. Kemp.
4281–83	Canara	Dr. F. Day.
13562	Koppa, Mysore	W. M. Daly.
9010–12	Khandalla, W. Ghats	W. T. Blanford, and Mus. Collr.
16245–47	Sasthancotta, Travancore	N. Annandale.
16260	Bycome, Travancore	N. Annandale.
17884	Chalakudi, Cochin State	F. H. Gravely.
9443	Mangalore	F. Day.
9075: 9071: 9074	Ceylon	Dr. Kelaart.
9017: 9057: 9060	Colombo, Ceylon	J. Anderson.
9033–4: 9036: 9039	Samagooting, Assam	Capt. Butler.
11371–2	Dilcoosh, N.E. Cachar	J. Inglis.
16567–8	Tavoy, Burma	R.E.P. Govt. of India.
9020	Mandalay, Burma	J. Anderson.
4166: 9061: 9064	Hotha, Yunnan	Yunnan Expdt.

Rana rugulosa, Wiegmann.

(Plate V, fig. 3).

1835. *Rana rugulosa*, Wiegmann, *N.A. Ac. Leop.* XVII, p. 258, pl. xxi, fig. 2.
1878. *Rana tigrina*, Anderson, *Zool. Anat. Res. Yunnan*, p. 837 (in part).
1907. *Rana tigerina*, Stejneger, *U.S. Nat. Mus. Bull.* 58, p. 139, figs. 127-131.
1910. *Rana burkilli*, Annandale, *Rec. Ind. Mus.* V, p. 79.

LARVA.

1899. *Rana tigrina*, Flower, *Proc. Zool. Soc. London*, p. 892, pl. lix, figs. 2, 2*a*.

Many other references to "*Rana tigrina*" probably refer wholly or in part to this frog, the adult of which differs from the true *R. tigrina* in the following characters:—

1. The size is smaller, the total length probably not as a rule exceeding 110 mm.,[1] and the habit stouter. In large specimens the head seems to be relatively smaller.

[1] A very large male specimen from Bangkok, recently sent me by Dr. Malcolm Smith, is 117 mm. long. It has the digits remarkably stout and the tips of the toes are almost globular. Dr. Smith, with whom I agree, regards this specimen as abnormal.

2. The snout is less pointed and the convexity of the outlines of the sides of the head as seen from above more marked and more regular. The length of the head is usually less than the breadth. The upper jaw projects very little beyond the lower.
3. The hind limb is shorter, the length of the tibia being in adult frogs considerably less than half that of the head and body. The fourth toe is also much shorter.
4. The dark and pale longitudinal stripes and bars conspicuous on the sides of the head and fore quarters of the young *R. tigrina* are totally absent. The pale mid-dorsal line, however, is sometimes present. There appears to be in the young a pale straight stripe extending from the upper posterior border of the tympanum to the lower anterior border of the orbit. The upper lip is marked with comparatively long vertical dark bars, while the lower lip is white, sometimes with irregular dark bars and bordered below with a dark line or row of spots. The throat is spotted with black[1] and the spots as a rule extend all over the ventral surface; they are always small and frequently tend to be connected together in such a way as to form a more or less complete reticulation.

Larva. From notes that Dr. Boulenger has been kind enough to send me it is clear that the tadpole from Bangkok described by Flower as that of *R. tigrina* was really that of *R. rugulosa*. It differs from the larva of the true *R. tigrina* in its much less flattened body (the abdomen being highly convex), in its strictly terminal mouth and lateral eyes. The armature of the mouth is identical. Dr. Boulenger has kindly sent me a specimen.

Distribution. *R. rugulosa* occurs all over Burma (except perhaps in Arrakan) in continental and northern Peninsular Siam, southern China, Formosa and perhaps the Philippines. The species was described from south-east China.

The following specimens are preserved in the Indian Museum:—

4175: 9008: 9022-3: 9020-1: 9447: 9517 ..	Mandalay, Upper Burma	.. Yunnan Expdt.: Capt. Sladen: Dr. J. Anderson.
9121 ..	.. Prome, Lower Burma ..	.. Yunnan Expdt.
4164-5 ..	.. Hotha, Yunnan ..	.. ,,
16569-70 ..	.. Tavoy, Tenasserim ..	.. R.E.P., Govt. of India. Types of *Rana burkilli*, Annandale.
18293-4: 18316-7	.. Bangkok, Siam ..	.. Dr. Malcolm Smith.
18310: 18315 ..	. Lopburi, Siam ..	.. ,,

In addition to these specimens I have examined an adult from Fokien in the Shanghai Museum and one from Koh Samuie, an island off the north-east coast of the Malay Peninsula, which Mr. Boden Kloss has kindly lent me. The latter is figured on plate v. Dr. Boulenger has sent me notes on specimens in the British Museum.

[1] In one specimen sent me for examination by Dr. Smith, the pigmentation of the throat is rather of the nature of a suffusion.

Rana cancrivora, Gravenhorst.

(Plate V, fig. iv).

1829. *Rana cancrivora*, Gravenhorst, *Rept. Mus. Zool. Vratisl.*, p. 41.
1834. ? *Rana vittigera*, Wiegmann, *N.A. Ac. Leop.* XVII, p. 255, pl. xxi, fig. i.
1907. *Rana tigrina* var. *angustopalmata*, van Kampen in Weber's *Zool. Ergebn. Nied. Ost.-Ind.* IV, p. 388, pl. xvi, figs. *3b*, *3c*.
1907. *Rana schlueteri*, Stejneger, *U.S. Nat. Mus. Bull.* 58, p. 142.
1912. *Rana tigerina* var. *schlueteri*, Barbour, *Mem. Mus. Comp. Zool. Harvard*, XLIV, No. 1, p. 64.
1912. *Rana tigrina*, Boulenger, *Fauna Malay Peninsula, Rept.*, p. 234 (in part, not the figure).

LARVA.

1907. *Rana tigrina*, var. *angustopalmata*, van Kampen, *op. cit.*, p. 389.
1909. *Rana tigrina*, *id.*, *Natuurk. Tijdsch. Ned.-Ind.* LXIX, p. 33.

The differential characters of this species are as follows:—

1. The size is still smaller than that of *R. rugulosa*, very large specimens not exceeding 90 mm. in total length. The habit is intermediate between that of *R. rugulosa* and *R. tigrina*.
2. The snout is still blunter than in *R. rugulosa*, but the sides of the head are as a rule a little straighter. The length of the head is distinctly less than the breadth in large specimens. The nostril is nearer the tip of the snout and the tympanum is more remote from the eye.
3. The vomerine teeth are often less well-developed than in *R. tigrina*, but seem to be somewhat variable. I have seen specimens in which they agree with those of *R. schlueteri* as redescribed by Stejneger, but this feature is not peculiar to Bornean individuals.
4. The webbing of the feet is much less extensive, largely owing to the margin being distinctly emarginate between the toes. The toes themselves, though not actually pointed, are more slender.
5. There are no pale stripes on the sides of the head and fore quarters even in quite young specimens, but a black band often extends backwards from each nostril over the eye and the tympanum, bending downwards to form a black border to the posterior margin of the latter. Both lips are heavily barred with black and spotted with white. The throat is usually mottled or marbled with brown and the mottling sometimes extends all over the ventral surface. There is often a white spot at the proximal end of the external metatarsal fold and a white line on the internal tarsal margin; otherwise the feet in adult specimens are heavily pigmented.

Larva. The larva has been described by van Kampen. According to his account it can hardly be distinguished from that of *R. limnocharis*. He states that the mouth-parts are identical and the only differential characters he gives are based on proportions and colouration, both of which are variable in the tadpole of *R. limnocharis*.

Geographical Distribution. The species was described from Java and Dr. van Kampen, who has been kind enough to examine the large specimen from Singgora figured on plate V, tells me it cannot be distinguished from Javanese examples. From Mr. Boulenger's notes it appears that *R. cancrivora* occurs all over the Malay Archipelago as far east as the Celebes. If I am right in regarding *R. vittigera*, Wiegmann, as a synonym, it also occurs in South China and the Philippines. There is a specimen from Mandalay in the British Museum, but I have not seen any from Burma myself. Most of the specimens in the Indian Museum are from the Siamese peninsular provinces of Sunkla (Singgora) and Patani.

In the country round the Talé Sap or Inland Sea of Singgora *R. cancrivora* is, in moderately damp places, by far the commonest frog. It is fond of sitting at the edge of ponds or ditches, and sometimes at that of the lake itself, and when disturbed dives into the water and buries itself in the mud at the bottom. Near Singgora it frequents ditches of brackish water and I saw a half-grown frog, which I subsequently captured, leaping into the sea from a rock at the mouth of the lake.

The following specimens are preserved in the Indian Museum. I have also examined others from the same localities that have now been distributed to various correspondents, as well as 17 specimens from North Borneo that the authorities of the Sarawak Museum have been kind enough to lend me, and several from Siam.

18185-6: 18123	.. Pools at edge of lake, Patalung, Talé Sap, Siam.	N. Annandale.
18180: 18188: 18192	.. Singgora, Siam	,,
18184 ..	.. Kaw Deng, opposite Singgora, Siam	,,
18183 ..	.. Kaw Ling Soan, nr. Singgora, Siam	,,
18048: 18181	.. Patani, Siamese Malay States ..	,,
18336 ..	.. Kuching, Sarawak	Sarawak Museum.

RANA TIGRINA, Daudin.

Nos.		Total length tip of snout to vent.	Width of head.	Snout to corner of mouth.	Diameter of eye.	Diameter of tympanum.	Width of upper eyelid.	Width of interorbital space.	Eye to nostril.	Eye to tip of snout.	Snout to fore leg.	Fore leg.	Tibia.	Inner metatarsal tubercle.
18177 ♂	..	108	37	35	12	8	6	8	11	18	43	45	53	5
18174 ♀	..	134	47	43	14	9	8	10	13	22	53	56	69	8
18221 ♂	..	121	45	41	13	10	7	11	14	24	44	50	57	5
18222 ♀	..	115	37	37	13	9	7	10	11	20	42	44	58	5
15869 ♀	..	60	20	22	7	6	4	6	6	11	24	26	28	4
18176 ♀	..	45	15	15	6	4	3	3	5	9	19	20	22	1·5
***RANA RUGULOSA*, Wiegmann.**														
4164 ♀	..	105	33	32	10	9	7	6	9	17	38	44	36	4
4165 ♂	..	96	31	29	11	9	8	6	8	16	35	43	40	3·5
16569* ♀	..	85	27	28	9	6	5	3	7	14	34	34·5	36	3
16570* ♀	..	84	30	26	9	5	6	3	7	14·5	30	33	35	3·5
18293	..	117	36	35	12	8	8	4	8	18	42	52·5	54	5·5
18294	..	85	29	28	9	5·5	6	5	8	14·5	33	37	28	3
***RANA CANCRIVORA*, Gravenhorst.**														
18048 ♀	..	85	34	24	9	6	5	4	9	14	26	35	38	5
18181 ♀	..	50	18	17	6	4	4	3	5	9	21	24	21	2·5
18188 ♀	..	55	15	18	8	4	3	4	7	10	24	28	29	3
18180 ♀	..	45	13	14	6	3	3	2	5	9	19	20	21	2·5
18186 ♀	..	43	14	15	5	3	3	2	4	8	19	23	19	2
18123 ♀	..	43	13	14	5	3·5	3	2	4	8	19	23	19	2

* Types of *Rana burkilli*, Annandale.

FROGS OF THE RANA LIMNOCHARIS GROUP.

In this group I include a number of comparatively small frogs, closely related to those of the *Rana tigrina* group, but distinguished by their less broadly webbed toes and by the presence of an inner metatarsal tubercle on the feet. So far as material before me renders a definite expression of opinion advisable, I believe that three species may be distinguished, and also three local races subspecifically distinct from the true *R. limnocharis*. The three species are *R. wasl*, nov., *R. limnocharis*, Wiegmann and *R. brevipalmata*, Peters.

R. wasl is a form intermediate between the two groups and has hitherto been confused with *R. tigrina* rather than *R. limnocharis*, to which it is allied in the structure of its feet. The species occurs side by side with *R. limnocharis* in N. Borneo, Burma and Assam. The true *R. limnocharis* has a very wide range in south-eastern Asia, but has produced certain slightly differentiated local races in mountainous or insular districts. So far as is at present known these races are:—

andamanensis (Stol.), which occurs, apparently to the exclusion of the typical form, in the Andaman Islands, but is also found occasionally on the mainland of Tenasserim;

greenii, Boulenger, from the hills of Ceylon;

nilagirica, Jerdon, from the Nilgiris and the Shevaroy Hills in South India.

Rana brevipalmata was originally described from Lower Burma. Boulenger was inclined to think that there was a mistake in the locality of the type-specimen, as he had only seen the species from the hills of south-western India; but if the tadpole here assigned provisionally to *R. brevipalmata* is correctly identified, the form certainly occurs in both parts of the Indian Empire.

Rana wasl, sp. nov.

(Plate V, fig. 5).

1912. *Rana tigrina*, Annandale, *Rec. Ind. Mus.* VIII, p. 8 (*nec.* Daudin).

Size moderate; habit rather stout; head long, moderately narrow; snout narrowly rounded, upper jaw projecting slightly, nostril much nearer tip of snout than eye, interorbital space much narrower than upper eyelid; limbs moderate, length of the tibia about half that of the head and body. Feet about half webbed, outer metatarsal tubercle very minute, inner metatarsal fold present, but by no means strongly developed. Dorsal surface with short longitudinal ridges: small rounded warts or granules present on the sides of the body and sometimes on the back, occiput and loreal region; a transverse fold often running across the dorsal surface of the head immediately behind the eyes. Ventral surface of head and body smooth, of sides somewhat granular.

Colouration as in *Rana tigrina* except that there is no trace of parallel black and white stripes on the head and anterior part of the body.

Type. No. 17282 (Rept. Reg. Z.S.I.).

Distribution. I have examined specimens of this frog from North Borneo, the Nicobars, Burma, the Khasi Hills and the extreme east of the Himalayan foothills. Doubtless it will also be found in the Malay Peninsula.

In general appearance it approaches *R. tigrina*, but its alliance with *R limnocharis* is evident on a close examination. It is the form I referred provisionally to *R. tigrina* in my account of the Batrachia of the Abor Expedition. The specimen from the Nicobars was identified by Stoliczka as *R. tigrina*.

The following specimens are preserved in the collection of the Indian Museum:—

17282 (TYPE) ..	Kuching, Sarawak	C. W. Beebe.
3544	Rangoon	F. Stoliczka.
9343	Moolet Range, 4-5000 ft., Tenasserim.	Tenasserim Expedition.
18941-2	Sadiya, N.E. Assam	S. W. Kemp (Abor Expdt.).
9416	Cherrapunji, Khasi Hills, Assam ..	Lt. Bourne.
8887 .. .	Camorta, Nicobars	Capt. Butler.

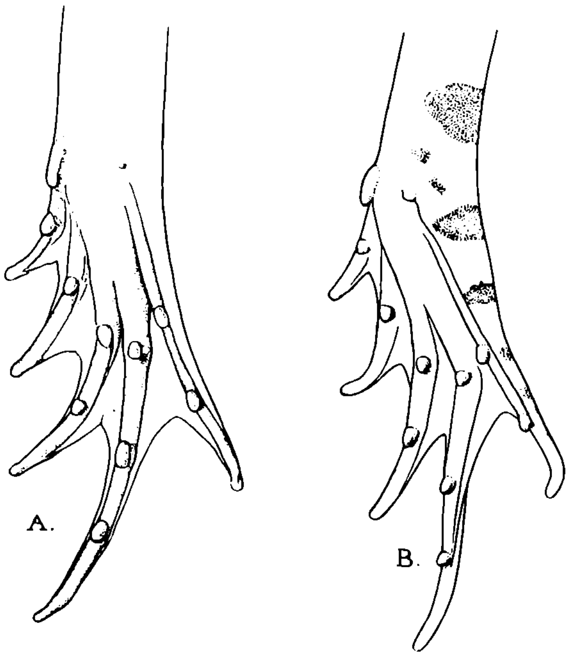

FIG. 3.—Feet of *R. wasl* (A) and *R. limnocharis* (B).

Rana limnocharis, Wiegm.

(Plate V, fig. 6; plate VI, fig. 2).

1835. *Rana limnocharis*, Wiegmann, *N. Acta Ac. Leop.-Carol.* XVII, p. 255.
1853. *Rana agricola*, Jerdon. *Journ. As. Soc. Bengal* XXII, p. 532.
1905. *Rana limnocharis*, Boulenger, *Spol. Zeyl.* II, p. 73.
1907. *Rana limnocharis*, Stejneger, *U.S. Nat. Mus.* No. 58, p. 127.
1912. *Rana limnocharis*, Boulenger, *Fauna Malay Peninsula, Rept.*, p. 236.

LARVA.

1909. *Rana limnocharis*, van Kampen, *Natuurk. Tijdsch. Ned.-Ind.* LXIX, p. 35.
1916. *Rana limnocharis*, Smith, *Jour. Nat. Hist. Soc. Siam* II, p. 165.

I have nothing to add to the excellent descriptions given by Boulenger and Stejneger. The frog has an immense range in south-eastern Asia and I am unable to find any difference between specimens from China, Borneo or Java and the common Indian form, which occurs all over the plains of India, Burma and Ceylon, ascending the Himalayas to an altitude of at least 7,000 ft. and the hills of Burma to one of at least 6,000 ft. It is unnecessary to give a list of the specimens in the Indian Museum, which include examples from China, Java and N. Borneo.

Larva. The tadpole has been described by van Kampen and, independently, by Smith. It differs greatly from that of *R. tigrina*, but closely resembles that of *R. cancrivora.* I figure a specimen from Madras on plate vi and give on p. 124 an enlarged outline of the mouth-disc.

Subsp. **andamanensis** (Stol.).

(Plate V, fig. 7).

1870. *Rana gracilis* var. *andamanensis*, Stoliczka (in part), *Journ. As. Soc. Bengal*, XXXIX, p. 142.

There are two specimens in the collection of the Indian Museum labelled as types of *Rana gracilis* v. *andamanensis*, Stoliczka The larger and better preserved of the two undoubtedly belongs to the species subsequently described by Boulenger as *R. doriae*, but the other, which I select as the type, represents a form sufficiently distinct to be recognized as a subspecies or local race of *R. limnocharis.* I have examined a series of this form from Baratang Island, one of the Andaman group, but it also occurs, apparently as a rarity and certainly with the typical form, in northern Tenasserim, where I captured a specimen myself some years ago.

This form closely resembles the *forma typica* except in its small size and peculiar colouration.

The dorsal surface of the head and body is of a rich chestnut-brown, while the sides are of a dark brown densely spotted with black. A narrow blackish line, sometimes running on a raised ridge or series of longitudinal folds, often separates the two areas; zig-zag dark bars sometimes run across the back and there is frequently a dark cross-bar between the posterior part of the eyes. The lips are more or less mottled and the throat feebly irrorated.

The following specimens are preserved in the collection of the Indian Museum:—

3539 (TYPE) ..	.. Andamans	F. Stoliczka.
15881-5 ..	.. Baratang Island, Middle Andamans	B. B. Osmaston.
15887 : 15982	.. ,, ,,	,,
16059 ..	.. Mudon, Tenasserim	N. Annandale.
14310 ..	.. Vebyu, Tenasserim	A. R. S. Anderson.

Subsp. **greenii**, Boulenger.

1905. *Rana greenii*, Boulenger, *Spol. Zeyl.* II, p. 73.

This form seems to be merely a dwarfed race peculiar to the hill-country of Ceylon. I am unable to say whether its range overlaps that of the typical form or not, but in the small series I have examined there is considerable variation in the degree of degeneracy exhibited by the internal metatarsal tubercle, the partial or complete disappearance of which is very characteristic.

The following specimens are preserved in the Indian Museum:—

15748	.. ..	Punduloya, Ceylon, ca. 4000 ft.	.. G. A. Boulenger.
17443-4	.. ..	Pattipola, Ceylon, 6200 ft.	.. S. W. Kemp.

Subsp. **nilagirica**, Jerdon.

1853. *Rana nilagirica*, Jerdon, *Journ. As. Soc. Bengal* XXII, p. 532.
1905. *Rana nilagirica*, Boulenger, *Spol. Zeyl.* II, p. 73.

I have examined a series of specimens from Ootacamund and Coonoor that exhibit an almost complete grading in structure between the typical form and Jerdon's *nilagirica*. The colouration is, however, characteristic; the dorsal surface much browner than in the typical form and there is a pale streak or spot between the eye and the proximal end of the lower jaw; the lips are dark with comparatively narrow vertical or sloping pale lines. The throat and chest are always more or less densely irrorated with brown atoms.

Larva. Tadpoles from the Nilgiris differ from those of the typical form in their extremely small mouth-disc and in other less important characters.

The following specimens are preserved in the collection of the Indian Museum:—

17158: 17214-5	..	Ootacamund, Nilgiri dist., Madras..	R. B. S. Sewell.
17169-71	.. ..	Coonoor, 6,000 ft., Nilgiri dist., Madras	,,
17880	.. ..	Shevaroy Hills, Madras	.. W. R. Sheriffs.

Rana brevipalmata, Peters.

(? Plate VI, fig. 5).

1871. *Rana brevipalmata*, Peters, *MB. Ak Berl.*, p. 646.
1905. *Rana brevipalmata*, Boulenger, *Spol. Zeyl.* II, p. 73.

LARVA.

? 1904. *Rana limnocharis*, Ferguson, *Journ. Bom. Nat. Hist. Soc.* XV, p. 501.

This species is probably distinct specifically, but I have seen only one specimen. It was described from Pegu and is stated by Boulenger to occur in the hills of south-western India.

Larva. Dr. Boulenger has suggested to me, as I had thought independently, that the tadpole described by Ferguson as that of *R. limnocharis* is possibly that of this species. It is certainly not that of the true *limnocharis*. I have examined specimens from Cochin and northern Tenasserim that I believe to be identical with Ferguson's larva, though they do not altogether agree with his description and figures. An outline of the mouth-disc of a specimen from Cochin is given here and a detailed drawing of the same individual is reproduced on pl. vi.

The following specimen is preserved in the collection of the Indian Museum:—

15747	..	.. Travancore	..	.. British Museum (Ex.).

THE MUTUAL RELATIONSHIP BETWEEN THE FROGS OF THE RANA TIGRINA AND R. LIMNOCHARIS GROUPS.

At first sight, if only the adult frogs were examined, it might seem that these two groups were quite distinct, if closely allied, *R. wasl* being in a way a connectant form but actually allied to *R. limnocharis* rather than to *R. tigrina*. The larvae however, so far as they are known, apparently fall not into two, but into three different groups and the lines of cleavage do not coincide with those that separate the adults.

Unfortunately the larva of *R. wasl* is unknown, but those of *R. tigrina* and *R. rugulosa*, on the one hand, differ in important characters from those of *R. limnocharis* and *R. cancrivora* on the other. The identity of the tadpole of *R. brevipalmata* is still doubtful, but, if the provisional identification here suggested should prove correct, it differs considerably from those of all the other species. The larva of *R. limnocharis nilagirica* agrees in essential features with that of the typical form of the species, but differs in minor characters.

The tadpole of *R. limnocharis* is by no means highly specialized. Its mouth-parts are of normal form and, in particular, bear a number of rows of teeth that seem to be common in the genus, *viz.* five. That of *R. cancrivora*, if we accept van Kampen's identification, only differs from that of *R. limnocharis* in colouration and proportions, features which are both variable. The tadpole of *R. tigrina*, on the other hand, has mouth-parts of a rather highly specialized kind, and differs, so far as I know, from all other tadpoles as yet described except that of *R. rugulosa* in the horny armature of the interior of the mouth; it has also an unusually powerful beak and numerous rows of teeth on the mouth-disc. All of these are probably adaptations for an active predaceous life. The supposed tadpole of *R. brevipalmata*, on the other hand, has fewer rows of teeth than is perhaps normal in the genus, *viz.* three; its beak is rather feeble and its mouth unarmed internally. Unfortunately we know nothing of its habits, but it probably feeds on minute organisms or decayed matter.

R. brevipalmata must be dismissed from further consideration in this connection owing to lack of precise information, but there are two interesting points in the adult frogs of *R. tigrina* and *R. cancrivora* which seem to bear out the view that they are convergent forms, less closely connected with one another by descent than *R. tigrina* and *R. rugulosa*. On the feet of *R. cancrivora* there is, as has already been pointed out, no internal metatarsal tubercle and the internal metatarsal fold is perhaps a little less well-developed than is normal in *R. tigrina*. At the proximal end of this fold, almost in the position in which the tubercle would be present, a distinct white spot can often be detected. In my opinion this spot must be regarded as a vestigial tubercle and indicates immediate descent from a form possessing the tubercle. I can find no spot in this position in specimens of *R. tigrina* or *R. rugulosa*.

The second fact is, that specimens of *R. tigrina* are occasionally found in India which approximate to *R. rugulosa* both in form and in colouration. There are two individuals in the collection of the Indian Museum that exhibit this tendency to a marked degree. One is from Orissa and the other from south-western India. Moreover, in frogs from Upper Burma there is, to some extent a gradation, between the two species.

For these reasons I am inclined to believe that *R. tigrina* and *R. rugulosa* are, strictly speaking, no more than two local races of a single species, using the term species in its broadest sense; whereas *R. cancrivora* is closely connected with *R. limnocharis* and resembles *R. tigrina* owing to convergence.

R. wasl is possibly in the strict sense of the phrase a connecting link between the *R. limnocharis* and *R. cancrivora*.

FROGS OF THE RANA LIEBIGII GROUP.

KEY TO *Rana liebigii* AND ALLIED SPECIES FROM THE HIMALAYAS.

1. Skin of back devoid of minute spinose warts and of elongate non-spinose warts.
   - A. Skin of back smooth or with relatively large, ill-defined prominences: a dark line, pale-edged, usually present along each side of the back: throat suffused with dark pigment: chest and abdomen pale, immaculate. Arms and chest unmodified, skin surrounding vent spinose in breeding male .. .. *R. vicina.*
   - B. Skin of back more or less warty: no dark dorso-lateral lines: whole of the ventral surface suffused with dark pigment; arms and chest spiniferous, no spinose skin round vent, in breeding male .. .. *R. liebigii.*
2. Skin of back bearing minute scattered warts of a more or less spinose character. (Arms and chest spiniferous in breeding male).
   - A. Habit rather slight: total length not exceeding 60 mm.: dorsal surface mottled: throat and chest minutely spotted, abdomen pale, immaculate .. .. *R. gammiei.*
   - B. Habit stout, total length reaching 85 mm.: dorsal surface uniformly dark: whole of ventral surface covered with an interrupted reticulation of dark spots and lines on a pale background .. .. *R. sternosignata.*
3. Back bearing short oval or linear, non-spinose warts: length not exceeding 40 mm. (No structural modifications in breeding male) .. .. *R. blanfordii.*

Rana liebigii (Gunther).

1860. *Rana liebigii*, Gunther, *Proc. Zool. Soc. London*, p. 157, pl. xxviii, fig. A.
1882. *Rana liebigii*, Boulenger, *Cat. Batr. Sal. B.M.*, p. 22, fig. (text in part only).

This is the largest and heaviest form of the alliance. To the naked eye it appears more warty than any of the others. There is, however, no trace of spinose cornified warts on its back. It is also the only species in which the whole of the ventral surface is suffused with dark pigment. This pigment is in some specimens marbled. There is always a longitudinal glandular ridge running the whole length of the back on each side. In the young frog in which the tail has not yet disappeared, the ridge is represented by a series of glandular warts. These are quite absent in *R. vicina* at this same stage.

R. liebigii seems to live chiefly at altitudes near the snow-line in the Eastern Himalayas. There is a specimen in the Indian Museum said to be from Ajmere, but this locality is probably incorrect.

Rana vicina, Stoliczka.

1871. *Rana gammiei* (in part), Anderson, *Journ. As. Soc. Bengal*, XL, p. 21.
1872. *Rana vicina*, Stoliczka, *Proc. As. Soc. Bengal*, p. 130.
1890. *Rana liebigii* (in part), Boulenger, *Faun. Brit. Ind., Rept.*, p. 445.
1892. *Rana vicina*, *R. assamensis* and *R. liebigii* (in part), Sclater, *Proc. Zool. Soc. London*, pp. 342, 343, pl. xxiv, figs. 1, 2.
1909. *Rana vicina*, *R. liebigii* (in part), Annandale, *Rec. Ind. Mus.* III, p. 282.
1912. *Rana liebigii*, *id.*, *Rec. Ind. Mus.* VIII, p. 8.
1913. *Rana liebigii*, Boulenger, *Rec. Ind. Mus.* IX, p. 337.

It is to this frog that the name *R. liebigii* has been most commonly applied in recent years, but it is a smaller, slighter and smoother species than the true *R. leibigii* and is well distinguished by its colouration by the vestigial or rudimentary nature of its lateral glandular folds and by the secondary sexual characters of the male. The type of Sclater's *Rana assamensis* has disappeared, but there are specimens in the Indian Museum that agree precisely with his figure, as well as others that provide a complete transition to the type of Stoliczka's *R. vicina*, which is still extant. The latter specimen is soft and faded and the apparent shape of the snout is evidently not quite natural. The dark, pale-edged line down each side of the back usually so conspicuous (see Sclater's fig. 2) has disappeared, and the feet are mutilated.

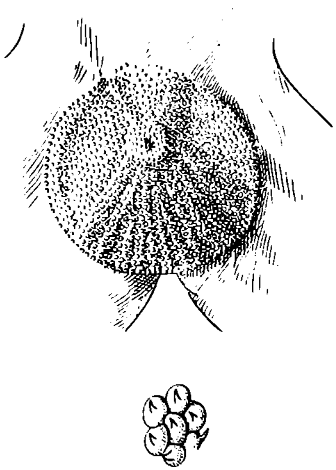

FIG. 4.—*R. vicina*.
Vent of breeding male (× 2) with papillae (× 16).

The most peculiar features of this species are the condition of the lateral fold and the secondary sexual character of the breeding male. At first sight, especially in specimens preserved in spirit, there often appears to be a well-developed fold, extending all along each side of the back, but a closer examination proves that this is an optical delusion due to the arrange ment of the dark lines to which I have already referred. The glandular structure, which is always fully developed, is strictly confined to the anterior third of the back.

In the breeding male there is no thickening of the arms and inner finger and no production of spines either on the fore limbs or on the chest, but round the vent there is formed a peculiar cutaneous flap of almost circular outline and covered with small papillae, each of which bears a short retroverted spine (fig. 4).

The natural colour of the back is dark brown. The sides, below the dorso-lateral streak, are paler. The throat is faintly suffused with dark pigment, but the belly is yellowish and immaculate. There is usually a dark cross-bar between the posterior extremities of the eye-lids but this is sometimes reduced to a spot on either side. There is a broad dark mark on each side of the head behind the eyes and the lips, and limbs are conspicuously barred. A few indistinctly developed prominences are sometimes present on the back and sides but, speaking generally, the skin is smoother than that of the allied species; it is never spinose except on the anal flap of the male.

The species is probably distributed throughout the Himalayas at moderate altitudes; its range extends eastwards into Assam and probably into Burma.

The following specimens are preserved in the collection of the Indian Museum:—

9147 (TYPE) ..	.. Murree, Punjab ..	.. Dr. F. Stoliczka.
9579 ..	.. Sikhim	.. Maj. Sherwill (A.S.B.).
9172 ..	.. Darjiling, E. Himalayas	.. J. Gammie.
14292-3 ..	.. Kurseong ,,	.. E. Barlow.

Rana gammiei, Anderson.

1871. *Rana gammiei* (in part), Anderson, *Journ. As. Soc. Bengal*, XL, p. 21.
1892. *Rana liebigii* (in part), Sclater, *Proc. Zool. Soc. London*, p. 343.

In describing *R. gammiei* Anderson confused two species, for while one of his type-specimens is undoubtedly an example of *R. vicina*, the others represents a distinct species closely allied to the one to which Boulenger subsequently gave the name *R. blanfordii*. This has naturally led to confusion, to which I fear that I have myself contributed.

R. gammiei may be distinguished at once from *R. vicina* by the presence on its back of small scattered warts each of which bears a minute spinule. The stature is also smaller, the figure slighter and the colouration of the body very different, the dorsal surface bearing numerous large blackish spots and blotches, while both the throat and chest are blotched with dark pigment. The secondary sexual characters of the male are those of *R. liebigii* and *R. sternosignata*, and there is no cutaneous anal flap, though the skin round the vent is distinctly tuberculate in the type.

There is a short almost linear longitudinal glandular area in the parotoid region.

Measurements of specimens.

	No. 9173.	N. 18265.
Snout to vent	53 mm.	44 mm.
Length of head	15 ,,	12 ,,
Breadth of head	20 ,,	15 ,,

No. 9173 is the type, the only specimen in the collection that has the male characters fully developed. A second specimen was recently taken by Dr. F. H. Gravely at Pashok (4,500 ft.) in the Darjiling district.

This frog is found in the Tista Valley at altitudes between 4,000 and 6,000 ft.

The following specimens are preserved in the collection of the Indian Museum:—

9173 (TYPE) ..	.. Darjiling, E. Himalayas ..	J. Anderson.
18265 ..	.. Pashok, 4,500 ft., Darjiling dist., E. Himalayas	F. H. Gravely.

Rana sternosignata, Murray.

1890. *Rana sternosignata*, Boulenger, *Faun. Brit. Ind. Rept.*, p. 445.

There has been no confusion about this species, of which an excellent description has been given by Boulenger. It occurs in Kashmir as well as in Sind and Baluchistan.

The following specimens are preserved in the collection of the Indian Museum:—

14713 : 14715 ..	.. Quetta	Maj. C. G. Nurse.
16452 ..	.. Srinagar, Kashmir	Bom. Nat. Hist. Soc. (Ex.).

Rana blanfordii, Boulenger.

1905. *Rana blanfordii*, Boulenger, *Ann. Mag. Nat. Hist.* (7), XVI, p. 640.
1907. *Rana vicina*, *id.*, *Rec. Ind. Mus.* I, p. 150.
1909. *Rana blanfordii*, Annandale, *Rec. Ind. Mus.* III, p. 282.

This species is closely allied to *R. gammiei*, but is much smaller and of stouter habit and is easily recognized by the different character of the warts on the back; they are more or less elongated and devoid of spines. The breeding male is also devoid of structural modifications. The colouration closely resembles that of *R. gammiei*.

In the western Himalayas, at altitudes from 7,000 to 10,000 ft., this species is very common, it often being the only batrachian that can be discovered readily. The locality of the type-specimen is uncertain.

The following specimens are preserved in the collection of the Indian Museum:—

15863 ..	.. Naini Tal, Kumaon, 6,400 ft. ..	N. Annandale.
17222-7 ..	.. ,, ,, ,,	J. A. Taylor.
16080-1 ..	.. Majkhal, Garhwal dist. ..	Mus. Collr.
17892 ..	.. Simla	Baini Parshad.
15900 ..	.. Matiana, 8,000 ft., Simla Hills ..	N. Annandale.
16362 ..	.. Near Phagu ,, ,,	,,

SOME FROGS CONFUSED WITH RANA TYTLERI AND RANA ERYTHRAEA.

Under this heading I propose to consider the species confused under the names of *R. tytleri* and *R. erythraea* in the *Fauna of India*. In subsequent papers cited in the text Boulenger has pointed out that several of these are distinct. I have also included several allied forms in the same category, as I find great confusion among the specimens of them in the Indian Museum. All these frogs are slender species of moderate size and with well-marked discs at the tips of the digits. The colour of the back as a rule contrasts strongly with that of the sides.

KEY TO THE FROGS OF THE *Rana erythraea* GROUP THAT OCCUR IN BURMA AND THE ISLANDS OF THE BAY OF BENGAL.

- I. Skin of back more or less granular.
  - A. Granules on back minute, evenly distributed.
    - 1. Granulation even; no pale vertical streak on sides of head; sides of body dark, reticulated with white; ventral surface with dark markings or suffusions .. *R. granulosa.*
    - 2. Granules on back more minute and more sparsely scattered; no pale vertical streak on side of head; sides uniformly dark; ventral surface pale .. .. *R. nicobariensis.*
  - B. Granules on back relatively large, confined to posterior region, scattered, a pale vertical streak between tympanum and eye; sides pale, with a few black spots or streaks; ventral surface pale *R. leptoglossa.*
- II. Skin of back smooth or minutely pitted.
  - A. Web of hind foot not reaching the discs of any of the toes; an outer metatarsal tubercle present on foot.
    - 1. Toes not more than half webbed, very long and slender.. *R. macrodactyla.*
    - 2. Toes more than half webbed, moderate.
      - a. A white ridge or fold extending upwards and forwards from behind the shoulder to the upper edge of the tympanum .. .. *R. lateralis.*
      - b. Sides of head uniformly dark; a pale longitudinal streak in the middle of the posterior part of the back .. .. *R. tytleri.*
  - B. Web of hind foot reaching the discs of all the toes but the fourth.
    - 1. No outer metatarsal tubercle; snout considerably longer than orbit; whole of ventral surface pale .. .. *R. erythraea.*
    - 2. An outer metatarsal tubercle present.
      - a. Throat darkened, with a pale longitudinal streak, snout considerably longer than orbit .. *R. alticola.*
      - b. Throat not darkened; snout barely longer than orbit .. .. *R. nigrovittata.*

Rana leptoglossa (Cope).

1868. *Hylorana leptoglossa*, Cope, *Proc. Nat. Sci. Philadelphia*, p. 139.

To this species I assign three specimens taken many years ago in Pegu by Stoliczka.

The habit of the frog is slight and the hind legs long; the tibio-tarsal articulation reaching the snout or beyond; the fingers and toes bear small discs, which are of oval shape; the first finger extends slightly beyond the second; the toes are half webbed, and there are two well-developed metatarsal tubercles on the hind foot. The anterior part of the back is smooth, but there are scattered tubercles on the posterior part and sides; ventral surface is smooth; there is a well-developed glandular lateral fold, a distinct glandule near the gape and another over the shoulder. A rather feeble fold extends obliquely downwards behind the tympanum from the lateral fold to the shoulder glandule. The tympanum is distinct and nearly as large as the eye. The sides of the tongue are nearly parallel.

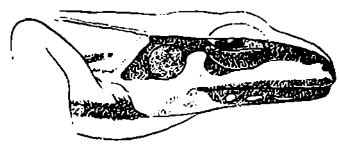

FIG. 5.—*R. leptoglossa.* Head of specimen from Pegu (× $1\frac{1}{2}$).

The colouration is distinctive; the back (in specimens long preserved in spirit) is of a pale livid grey; the sides are rather darker, the hind limbs bear indefinite cross-bars; the sides of the head are dark brown; a rather broad grey band extends backwards from the tip of the snout to behind the tympanum, while another extends upwards between the eye and the tympanum; the lips are edged with brown, but there are sometimes pale spots on the lower lip; there is an oblique black band on the basal part of the humerus in front and another behind the axilla; sometimes black spots are present on the sides.

The species, which was described from near Rangoon, is closely related to *R. granulosa*, Anderson, from which it may be distinguished by its longer hind limbs, by its colouration and by the smoothness of the skin on the head and anterior part of the body.

The following specimens are preserved in the collection of the Indian Museum :—

3574-5: 10816 .. Pegu L. Burma .. .. F. Stoliczka.

Rana tytleri (Theob.).

1868. *Hylorana tytleri*, Theobald, *Cat. Rept. As. Soc. Mus.*, p. 84.
1870. *Hylorana tytleri*, Stoliczka, *Journ. As. Soc. Bengal*, XXXIX (2), p. 148, pl. ix, fig. 1.
1890. *Rana tytleri* (in part), Boulenger, *Faun. Brit. Ind. Rept.*, p. 458.
1892. *Rana erythraea* (in part), Sclater, *Proc. Zool. Soc. London*, p. 345.
1912. *Rana alticola*, Annandale (in part), *Rec. Ind. Mus.* VIII. p. 8 (*not* p. 22).

Sclater was certainly mistaken in regarding this species as synonymous with *R. erythraea*, from which it is distinguished not only by the presence of an inner metatarsal tubercle on the feet, but also by the less extensive webbing and by colouration. In the young frog the sides and back are brownish and sometimes spotted, but in the adult they are bright green, without spots; in spirit the green changes to dark brown or blackish grey, the glandular fold, which extends from the eyes to the base of the hind limbs, is silvery white, and the lower limits of the green region of the sides are diffused by a white line running parallel to it and terminating in front in a glandule between the shoulders and the tympanum; there is a faint whitish line in continuation of the lateral fold on the supercilliary region and canthus rostralis. A very characteristic point in the colouration is a white longitudinal streak in the middle of the posterior part of the back; the lateral folds of each side connect with this streak at the posterior extremity. The lips are white, sometimes suffused with a dark pigment, the sides below the lower white line bear numerous dark spots and the ventral surface of the throat, abdomen and sides are often marked with smaller dark spots, which sometimes form a regular suffusion; the posterior part of the thighs are boldly marked with green or black and white, the limbs are not cross barred.

The type (from Dacca) is still in fairly good condition, but faded; it is very much larger than any other specimen I have seen, the total length of the head and body being 61 mm.; the next specimen in point of size, which comes from Tenasserim, is only 44 mm. long, while the average length of apparently adult specimens from Orissa does not exceed 36 mm.

The range extends from Tenasserim all round the head of the Bay of Bengal to Orissa. The species is found in the plains.

The following is a list of specimens preserved in the collection of the Indian Museum:—

10035 (TYPE)	Dacca	Lt.-Col. Sykes.
17002-6	Balighai, nr. Puri, Orissa	N. Annandale.
2759	Garo Hills, Assam	Maj. H. H. Godwin-Austen.
17277	Selai Kusi, Mangaldai, Assam	S. W. Kemp.
9404-5	Shway-goo-myo, U. Burma	Yunnan Expdt.
2684: 10033-4	Pegu	W. Theobald.
16054-6: 16061-5	Mudon, Amherst district	N. Annandale.
16071-2: 16074	Tenasserim	,,

Rana granulosa (Anderson).

1871. *Hylorana granulosa*, Anderson, *Journ. As. Soc. Bengal*, XL, p. 23.
1892. *Rana granulosa*, Sclater, *Proc. Zool. Soc. London*, p. 346.
1893. *Rana granulosa*, Boulenger, *Ann. Mus. Genova*, XIII (2nd. Ser.), p. 333. pl. viii, fig. 2.
1912. *Rana granulosa*, Annandale, *Rec. Ind. Mus.* VIII, p. 9.

This well-marked species is found in north-eastern Assam, Upper and Lower Burma and western Yunnan.

The following specimens are preserved in the collection of the Indian Museum:—

2789-90: 4009: 10830 (TYPES)	Sibsagar, Assam	S. E. Peal.
16930	Dibrugarh, N.E. Assam	S. W. Kemp (Abor Expdt.).
8975	Mooleyet, Tenasserim	Tenasserim Expdt.
11844	Taing, King's Isle, Mergui	Mergui Expedt.

Rana nicobariensis (Stol.).

1870. *Hylorana nicobariensis*, Stoliczka, *Journ. As. Soc. Bengal*, XXXIV, pt. 2, p. 150, pl. ix, fig. 2.
1885. *Rana nicobariensis*, Boulenger, *Ann. Mag. Nat. Hist.* (5) XVI, p. 389.

1890. *Rana nicobariensis, id., Faun. Brit. Ind. Rept.*, p. 459.
1912. *Rana nicobariensis, id., Faun. Malay Penin. Rept.*, p. 240.

A Malay specimen agrees well with the types.

R. nicobariensis is a Malayan rather than an Indian species, occurring in the Nicobars, the Malay Peninsula and the Sunda Islands.[1] In the Malay Peninsula it has always been found in or near caves.

My specimens were taken in semi-darkness a short distance within the mouth of the Goah Glap (Dark Cave) near Bisarat.

The following specimens are preserved in the collection of the Indian Museum :—

2783 : 2785-6 (TYPES)	Nicobars	F. Stoliczka.
3562-3 : 3565-70	Nicobars	,,
18080	Goah Glap, Bukit Tapang, Jalor, Malay Peninsula.	N. Annandale.

Rana macrodactyla (Gunther)

1858. *Hylorana macrodactyla*, Gunther, *Cat. Batr. Sal.*, p. 72, pl. ii, fig. C.
1864. *Hylorana macrodactyla, id., Rept. Brit. Ind.*, p. 424.
1882. *Rana macrodactyla*, Boulenger, *Cat. Batr. Sal. B.M.*, p. 54.
1890. *Rana macrodactyla, id., Faun. Brit. Ind. Rept.*, p. 455.

Distribution. Burma, Siam, Malay Peninsula, Tonkin and Southern China.

The following specimens are preserved in the collection of the Indian Museum :—

9406	Shway-goo-myo, Upper Burma	Yunnan Expdt.
2698	Pegu, Lower Burma	W. Theobald.
16073	Mudon, Amherst dist., Burma	N. Annandale.

Rana lateralis, Boulenger.

1887. *Rana lateralis*, Boulenger, *Ann. Mus. Genova* (2) V, p. 483, pl. viii, fig 2.
1890. *Rana lateralis, id., Faun. Brit. Ind. Rept.*, p. 457.
1900. *Rana lateralis*, Laidlaw, *Proc. Zool. Soc. London*, p. 886, pl. lvii, figs. 1, 2.
1912. *Rana lateralis*, Boulenger, *Faun. Malay Penin. Rept.*, p. 239.

This species is only known from Tenasserim and the north-eastern part of the Malay Peninsula.

The specimens in the Indian Museum have not the fine transverse dorsal folds noted by Laidlaw (1900) in his Malay example.

The following specimens are preserved in the collection of the Indian Museum :—

2758	Moulmein, Tenasserim	Purchased.
9525	Hatsiga, Tenasserim	Tenasserim Expdt. (Limborg).

Rana erythraea (Schleg.).

1890. *Rana erythraea*, Boulenger, *Faun. Brit. Ind. Rept.*, p. 460.
1896. *Rana erythraea*, Flower, *Proc. Zool. Soc. London*, p. 902, pl. xlv, fig. 2.

[1] The Javanese form (*R. javanica*, Horst), of which I have minutely examined a specimen, is I believe distinct. See van Kampen in Weber's *Zool. Ergebn. Nederl. Ost.-Ind.*

LARVA

1909. *Rana erythraea*, van Kampen, *Natuurk. Tijdsch. Ned.-Ind.* LXIX, p. 35.

The species appears to be rare in Indian territory, but is found as far north-west as the north-eastern corner of Assam. It is widely distributed in the nearer islands of the Malay Archipelago and occurs in Siam.

The tadpole has been described by van Kampen.

The following specimens are preserved in the collection of the Indian Museum :—

3963	Tezpur, N. Assam	Maj. H. H. Godwin-Austen.
4841	Taoo, Tenasserim	Tenasserim Expdt.
17283-4	Kuching, Sarawak	C. W. Beebe.
18076-7	Botanical Gardens, Penang ..	N. Annandale.

Rana nigrovittata (Blyth).

1855. *Limnodytes nigrovittatus*, Blyth, *Journ. As. Soc. Bengal*, XXIV, p. 718.

1893. *Rana nigrovittata*, Boulenger, *Ann. Mus. Genova*, XIII (2nd Ser.), p. 334, pl. viii, fig. 3.

LARVA.

1916. *Rana nigrovittata*, Smith, *Journ. Nat. Hist. Soc. Siam*, II, p. 42, pl.——.

The species is recorded from Tonkin, Burma, Siam and the Malay Peninsula.

The following specimens are preserved in the collection of the Indian Museum :—

2685 : 2773 (TYPES) ..	Pegu, Lower Burma	W. Theobald.
9526-32	Meetan, 3,500 ft., Tenasserim ..	Tenasserim Expdt.
9523	Hatsiga, Tenasserim	,,

Rana alticola, Boulenger.

1882. *Rana alticola*, Boulenger, *Cat. Batr. Sal. B.M.*, p. 65.

LARVA.

1912. *Rana alticola*, Annandale, *Rec. Ind. Mus.* VIII, p. 22, pl. iv, fig. 1.

This is evidently a common frog in the Khasi Hills and north-eastern Assam but I have not seen many fresh specimens. It occurs also in Tenasserim.

The following specimens are preserved in the collection of the Indian Museum :—

10039 : 10041-5 ..	Khasi Hills, Assam	Dr. T. C. Jerdon. (Types of *Hylorana pipiens*, Jerdon.
10197-8	Samagooting, Assam	Capt. Butler.
10470	Sibsagar, Assam	S. E. Peal.
10441-3 : 10445-50 : 10452-6 : 10458-64 ..	Cherrapunji, Assam	Lt. Bourne.
11370	Dilcoosh, N. E. Assam	C. Cadell.
4844-6 : 9544-9 ..	Ashsoon, Tenasserim	Tenasserim Expdt.
10474-8 : 10483 : 10485-7 : 10480-1	Stream between Ashsoon and Meetan	,,
	Mangaldai div., Darrang dist., N.E. Assam, on Bhutan-Assam frontier	S. W. Kemp.

MISCELLANEOUS RECORDS OF FROGS.

Oxyglossus lima (Gravenh.).

1912. *Oxyglossus lima*, Boulenger, *Fauna Malay Peninsula, Rept.*, p. 225.

LARVA.

1907. *Oxyglossus lima*, van Kampen, in Weber's *Zool. Ergebn. Ost.-Ind.* IV, p. 384, pl. xvi, fig. 1.
1909. *Oxyglossus lima*, *id.*, *Natuurk, Tijdsch. Ned.-Ind.* LXIX, p. 44.
1916. *Oxyglossis lima*, Smith, *Journ. Nat. Hist. Soc. Siam* II, p. 173, pl.——.

Several specimens were taken at the edge of the Talé Sap and in ditches at Patalung in the Siamese Peninsular Province of Singgora.

Oxyglossus laevis subsp. **martensi**, Peters.

1912. *Oxyglossus laevis*, Boulenger, *Fauna Malay Peninsula, Rept.*, p. 225.
1916. *Oxyglossis laevis martensi*, Smith, *Journ. Nat. Hist. Soc. Siam* II, p. 172.

LARVA.

1916. *Oxyglossis laevis martensi*, Smith, *op. cit.*, p. 174, pl.——

Two specimens were taken in a small pool in the casuarina woods near the town of Singgora. The species is common in situations of the kind on the east coast of Peninsular Siam.

Rana cyanophlyctis, Schneid.

1912. *Rana cyanophlyctis*, Boulenger, *Fauna Malay Peninsula, Rept*, p. 228.

I obtained a perfectly typical specimen of this species at the edge of the Talé Sap near the mouth of the Patalung River. The evidence of its occurrence in the Malay Peninsula has hitherto been very doubtful, depending on two specimens from Cantor's collection, labelled "Penang."

Rana plancyi, Lataste.

1907. *Rana plancyi*, Stejneger, *U.S. Nat. Mus. Bull.* 58, p. 101.

This frog is common round the Tai-Hu Lake in the Kiangsu Province of China, where I obtained several specimens.

Rana namiyei, Stejn.

1907. *Rana namiyei*, Stejneger, *op. cit.*, p. 136, figs. 122-126.

This species was described from fully adult specimens from the Liu-Kiu Islands. Stejneger compares it with *Rana corrugata* and *Rana kuhlii*, but it seems to be most closely related to *Rana macrodon*, from which it differs in its much less strongly developed palatal teeth. I have examined a half-grown specimen from Kuling in China that seems to belong to the species. It differs from the adult in exactly the same way as half-grown specimens of *R. macrodon* do, *viz.* chiefly in the narrower and smaller head and in the comparatively feeble development of the prominences in front of the lower jaw. Otherwise the agreement with Stejneger's description and figures is complete. Our specimen was obtained in exchange with the Shanghai Museum.

Rana glandulosa, Boulenger.

1912. *Rana glandulosa*, Boulenger, *Fauna Malay Peninsula, Rept.*, p. 236.

A specimen was recently taken by Mr. J. Coggin Brown of the Geological Survey of India at Mongbong, Hsipaw, North Shan States. This, so far as I am aware, is the first record of the species from Burma.

Kaloula pulchra, Gray.

1912. *Callula pulchra*, Boulenger, *Fauna Malay Peninsula, Rept.*, p. 264.
1912. *Kaloula pulchra*, Barbour, *Mem. Mus. Zool. Harvard*, xliv p. 71, pl. vii, fig. 29.

LARVA.

1916. *Callula pulchra*, Smith, *Journ. Nat. Hist. Soc. Siam*, II, p. 40, pl.——, figs. B1-B3.

The correct spelling of the generic name of this species has recently been discussed by Barbour.[1] I find myself obliged to accept his decision in the matter.

K. pulchra, which is one of the commonest forms in the northern part of the Malay Peninsula, is apparently rare in northern India. I have recently examined a living specimen taken by Miss Maud Cleghorn in the outskirts of Calcutta. It differs from all the Malay individuals I have seen in having the pale markings[2] on the back of a bright red colour instead of dull yellowish Miss Cleghorn tells me that the red fades considerably when the animal is in a disturbed condition. A specimen was recently taken by Mr. T. Bainbrigge Fletcher at Pusa; its colour was apparently similar to that of the Calcutta example. A specimen from Celebes figured by Barbour (*op. cit.*, 1912) seems to have been even paler than Malay examples.

I have some remarks to make on the eggs and tadpoles below (p. 152).

SOME TADPOLES FROM JAPAN, CHINA, THE MALAY PENINSULA, BURMA AND CEYLON.

Under this heading I propose to discuss tadpoles of several frogs and toads from different parts of the Oriental Region, with one species from Japan.

? **Rana nigromaculata**, Hallowell.

(Plate VI, fig. 4.)

1882. *Rana esculenta* var. *japonica*, Boulenger, *Cat. Batr. Sal. Brit. Mus.*, p. 40.
1907. *Rana nigromaculata*, Stejneger, *U.S. Nat. Mus. Bull.* 58, p. 94, figs. 76-80, pl. x, fig. 1.

On October 15th, 1915, I obtained in Lake Kasumi-ga-Ura on the east coast of the Main Island of Japan a tadpole that I assign provisionally to this species. The

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[1] Barbour, *Proc. Acad. Nat Sci., Philadelphia*, p. 405 (1909).

[2] I refer to the major markings; some specimens from the Malay Peninsula have small carmine spots on the back, just as some specimens of *Bufo melanostictus* do. Miss Cleghorn has recently obtained a second specimen near Calcutta similar to the first in colouration.

hind legs are represented by small buds, and it seems probable that the animal would have hibernated through the winter before its metamorphosis. My provisional identification is based on its close resemblance to a small series of tadpoles and young frogs from Korea sent by the British Museum under the name *Rana esculenta* var. *chinensis*. It differs from Boulenger's figures of the tadpole of the European *R. esculenta* in the following points:—

1. The head and body are relatively larger and the tail both shallower and shorter.
2. The spiracle is situated rather higher on the body.
3. The papillae and processes on the mouth-disc are more digitiform and not arranged precisely in the same manner.
4. The margin of the upper beak is almost straight.
5. The rows of teeth on the upper lip are relatively shorter.

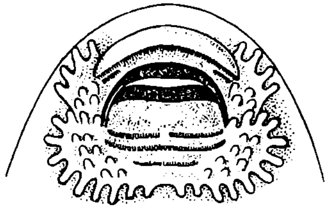


FIG. 6.—Mouth-disc of ? *R. nigromaculata* (× 12).

Measurements of Japanese tadpole:—

Length of body	12	mm.
Breadth of body	8·5	,,
Length of tail	20·5	,,
Depth of tail	6·5	,,

Bolkay's[1] figures of the tadpoles of *Rana esculenta* and *Rana ridibunda* (which is certainly no more than a variety) differ considerably in all these points from Boulenger's[2] and it is probable that considerable variation exists. I follow Stejneger in regarding the Japanese and Chinese form allied to *R. esculenta* as specifically distinct, but the differences are slight in the adult.

Rana kuhlii, D.

1912. *Rana kuhlii*, Boulenger, *Fauna Malay Peninsula, Rcpt.*, p. 229.

Capt. F. H. Stewart, I.M.S., has recently sent me a young frog of this species, which he took in a small pool on the Peak of Hongkong. With it he has also sent two tadpoles from the same pool. Of course it is impossible to be certain that these tadpoles belong to the same species, and the specimens are rather shrivelled. It may, however, be as well to describe them, in case others similar to them should be found again in more satisfactory circumstances.

They closely resemble the larvae of *Rana macrodon* so far as external appearance and general colouration are concerned, but differ considerably in the structure of the mouth-parts and in certain minute but important features of the markings. The mouth-disc is ventral and of a transversely oval shape; except in front, it is edged with very minute papillae. The upper lip is better developed than in *R. macrodon*

[1] Bolkay, *Ann. Mus. Nat. Hung.* VII, pp. 108, 111; pl. ii, figs. 1 and 2 (1909).
[2] Boulenger, *Proc. Zool. Soc. London*, p. 604, pl. xlv, fig. 1 (1891).

and there is a distinct emargination in the centre of the lower margin of the posterior lip. The dental formula is 1 : 3+3/1+1 : 2. The second row of teeth on the upper lip and the first on the lower lip are very slightly interrupted. The beak is black, except at the base of the lower mandible, where it is brownish. The upper beak is narrowly crescentic and minutely serrated. The lower beak, which is much broader, is V-shaped; it is also serrated. So far as colouration is concerned, the tadpoles resemble those of *R. macrodon* in the dark bars on the tail and blotches on the body, but while in the larva of *R. macrodon* the ventral surface of the body is entirely unpigmented, in the present species it is closely covered with short microscopic hair-like dark lines, which run in all directions without crossing one another.

Measurements:—

Length of body	10·5 mm.
Breadth of body	6 ,,
Length of tail	18 ,,
Depth of tail	3·5 ,,

Rana macrodon, D. and B.

1912. *Rana macrodon*, Boulenger, *Fauna Malay Peninsula, Rept.*, p. 233.

LARVA.

1899. *Rana macrodon*, Flower, *Proc. Zool. Soc. London*, p. 889, pl. LIX, fig. 1.

In a small jungle-stream on Penang Island I found in February 1916 a number of young frogs and tadpoles of this species. The older tadpoles agree well with Flower's figure, but the younger ones are less conspicuously marked. In the uncertain light of the jungle the dark bars and blotches form an excellent protective colouration on a sandy bottom. Tadpoles of *R. limnocharis* from streamlets on the Peak of Hong-kong closely resembled this species in colouration (except that they were less yellow) and were equally well hidden.

The larvae of *R. macrodon* evidently obtain their food by swallowing large quantities of sand, as their intestines are filled with that substance. They probably avoid the rocky parts of the stream in which they live.

Measurements:—

Length of body	9·5 mm.
Breadth of body	6 ,,
Length of tail	19 ,,
Depth of tail	4·5 ,,

Rana labialis, Boulenger.

(Plate VI, fig. 5.)

1912. *Rana labialis*, Boulenger, *op. cit.*, p. 242.

LARVA.

1896. *Rana labialis*, Flower, *Proc. Zool. Soc. London*, p. 903, pl. xlv, fig. 3.

In a small rocky pool at the edge of a stream at the base of the hills near Taiping I found in January 1916 a number of tadpoles that seem to be identical with those assigned to *Rana labialis* by Flower. They are, however, in a less advanced stage than the individual figured by him, having the hind legs as mere buds. The caudal fin is lower and more sinuous and the dark markings on the head and body are slightly different. The mouth-parts are, however, identical and the curious patches of granular skin on the dorsal, lateral and ventral surfaces, though variable in size and outline, very similar. The integument was of a bright yellow colour in life. The patches of granular skin are assemblages of ploygonal multicellular glands, each of which is provided with a minute circular orifice, while the whole structure is enmeshed in a network of minute blood vessels.

This peculiar tadpole closely resembles that of the Javanese *Rana chalconota*,[1] with specimens of which, thanks to the kindness of Dr. van Kampen, I have been able to compare it.

Measurements:—

Length of body	12 mm.
Breadth of body	7 ,,
Length of tail	17 ,,
Depth of tail	5·5 ,,

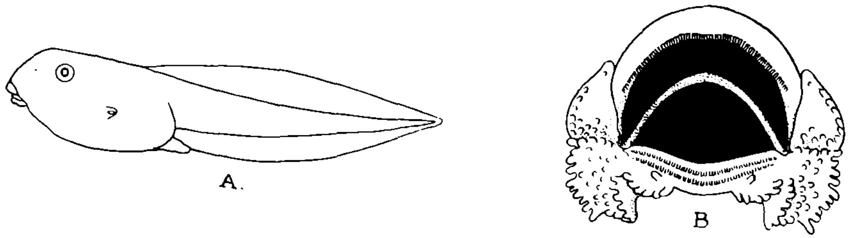


FIG. 7.—Tadpole of *R. corrugata*.
A.—Lateral view of whole animal (× 3).
B.—Mouth-disc (× 16).

Rana corrugata, Peters.

1890. *Rana corrugata*, Boulenger, *Faun. Brit. Ind. Rept.*, p. 443.

A small but nearly complete series of tadpoles and a young frog of this species was found by Dr. F. H. Gravely some years ago in Lady Blake's Drive near Kandy, Ceylon. They were living in a small rocky pool the water of which was heated to a high temperature by the sun.

The head and body is stout, oval and rounded, slightly flattened behind the eyes, which are large and prominent. The nostrils are small, situated laterally, as a rule nearer the tip of the snout than the eye. The spiracle is situated about half way down the body, a little nearer the vent than the eye: it opens directly outwards on a small papilla. The anus is distinctly dextral. The tail is relatively short and deep, regularly lanceolate in outline, not much more than one and a half times as long as

[1] van Kampen, in Weber's *Zool. Ergebn. Ost.-Ind.* IV, p. 392 (1907) and *Naturk. Tijdsch. Ned.-Ind.* LXIX, p. 37.

the head and body. Both fin-membranes are well-developed and broad. The mouth opens ventrally, but the structures connected with it appear to project forwards in lateral view. The anterior part of the upper lip is devoid of tubercles and forms a kind of hood over the upper beak. There is a conspicuous lateral lobe of triangular outline on each side. The lower lip is lobulate and covered, except in the middle part of the posterior margin, by small but somewhat elongate tubercles. There are three uninterrupted rows of teeth, the formula being 1/2. The anterior row forms a border to the upper lip and is a little longer than the two posterior rows, which are subequal. The beak is extremely massive and prominent; it is entirely black. The upper beak is regularly crescental in shape and has a smooth margin; the lower beak is almost semicircular. The specimens are of an almost uniform darkish black, but have probably been discoloured by the use of some fixative. There are apparently numerous small tubercles or warts on the dorsal and lateral surfaces of the head, but I am not sure that this is not due to bad preservation, the preservative having caused the skin to degenerate to some extent. I am unable, perhaps in consequence of this circumstance, to detect any muciferous glands.

Measurements:—

Length of body	.. ..	10 mm.
Breadth of body	.. ..	5 ,,
Length of tail	.. ..	13 ,,
Depth of tail	.. ..	6 ,,

The peculiar structure of the beak distinguishes this tadpole from all others with which I am acquainted.

Microhyla achatina (Boie).

(Plate VI, fig. 6).

1912. *Microhyla achatina*, Boulenger, *op. cit.*, p. 261.

LARVA.

1916. *Microhyla achatina*, Smith, *Journ. Nat. Hist. Soc. Siam*, II, p. 37, pl.——, figs. A1-A4.

Smith has recently described this tadpole from Siam. I obtained specimens which agree in all important characters with his figures in a pool in the Botanic Gardens at Penang. The most striking feature is the peculiar structure of the lower lip, which in some respects resembles that of the larva of *Megalophrys montana* and other species of that genus. When the tail is complete it is produced at the tip into a distinct flagellum. The colouration is probably variable. In my specimens it appears to have been more conspicuous than in Smith's (see fig. 6, pl. vi); the pale markings on the upper part of the head and body and the fleshy part of the tail were of a golden green colour, those on the membranes quite transparent; the abdomen was iridescent white.

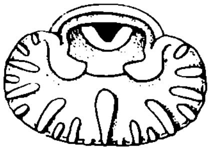


FIG. 8.—Tadpole of *Microhyla achatina*. Mouth-disc as seen from in front.

Measurements :—

Length of body	.. ..	8 mm.
Breadth of body	.. ..	3·5 ,,
Length of tail	.. ..	12 ,,
Depth of tail	.. ..	5 ,,

? Microhyla berdmorei (Blyth).

1912. *Microhyla berdmorii*, Boulenger, *op. cit.*, p. 263.

LARVA.

1899. "Transparent tadpoles," Flower, *op. cit.*, p. 903, pl. LX, fig. 2.

It seems probable that Flower's "transparent tadpoles" from Penang are those of *M. berdmorei*, because they agree with those of other species of *Microhyla* in having a distinct flagellum at the end of the tail,[1] and because only three species of the genus, so far as we know, occur commonly in the Malay Peninsula at low altitudes; these three species are *M. ornata*, *M. achatina* and *M. berdmorei*, and the tadpoles from Penang are very different from those of either of the two former species.

I found numerous specimens in the Botanic Gardens at Penang, both in the pool in which those of *M. achatina* occurred and in a small cistern in a fern-house. They differ from the specimens examined by Flower in being rather darker and in having the anterior two-thirds of the ventral surface profusely dotted with black pigment cells; but this difference is more marked in the specimens from the pool than in the others. In the specimens from the pool the tail was suffused with bright scarlet. The black streak near the vent is always a very characteristic feature.

In the pool the tadpoles were divided into several shoals, each of which hung level and motionless in mid-water at some distance from the others. In each shoal the heads of all the tadpoles were pointed in one direction. Often the formation was wedge-shaped with several ranks, like that of a flock of wild geese on the wing. The front rank of one shoal was often opposed to or at an angle with that of another. When they were disturbed the tadpoles scattered in all directions, but reassembled almost immediately in their respective shoals. The number of individuals in a shoal varied considerably, but was never much more than about fifty.

Measurements :—

Length of body	.. ..	11·5 mm.
Breadth of body	.. ..	8 ,,
Length of tail	.. ..	16 ,,
Depth of tail	.. ..	6 ,,

[1] My attention has been drawn to this generic character by Mr. C. R. Narayan Rao.

Kaloula pulchra, Gray.

(Plate VI, figs. 7, *7a*, *7b*).

Both Butler[1] and Smith[2] have observed the oviposition of this species, and the latter has described the adult tadpole, but neither appears to have noticed the peculiar form of the eggs, and neither says anything of the young larval stages. In a period of heavy rain at Christmas, 1915, I was able to note several additional points in the case of frogs breeding in small pools in the Botanic Gardens, Singapore.

The eggs, though expelled in a mass, do not adhere to one another. If observed undisturbed on the surface of water, they appear to form a coherent layer, but if stirred up by a stick separate immediately. The ova are spherical, having the upper half black and the lower half white. Their diameter is 1·5 mm. The peculiarity lies in the form of the jelly that surrounds each egg. It is perhaps stiffer than is usually the case in the eggs of frogs and toads, and is not completely spherical; one surface being flattened on a considerable area. The balance of the whole egg is such that this flattened surface lies immediately below the surface-film of the water and that, however the egg may be disturbed, it always reassumes the same position almost instantaneously. This seems to be advantageous in the case of eggs laid in temporary pools of rain-water, which are liable to be greatly enlarged or to form part of temporary torrents owing to flooding. The eggs, instead of being washed away into corners in such circumstances or stranded on dry ground, as would be the case if they adhered together to form a solid and heavy mass, float lightly on the surface without injury and with very little chance of being stranded.

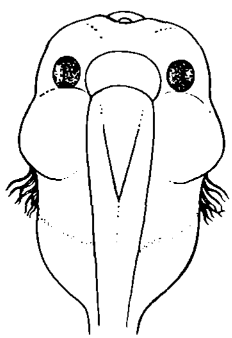


FIG. 9.—Tadpole of *Kaloula pulchra*. Dorsal view of head and body of a specimen hatched 24 hours (× 20).

I was unable to observe the larva immediately after hatching, but figure 7 on pl. vi and text-fig. 9 represent one 24 hours old. At this stage the mouth is already open, but the anus is still closed and a large amount of yolk still remains in the body-cavity. There are about 7 "external" gill-filaments present on each side. The larval adhesive apparatus is at different stages in different individuals of this age. In the specimen figured it is merely represented by a slight lateral ventral prominence on each side, but in smaller tadpoles from the same batch the prominence is entirely ventral and takes the form of a deeply pigmented conical papilla tipped with white. These tadpoles provide no evidence that the structure as a whole has ever been V-shaped or that the two papillae have been concave at the tips. It does not differ, however, materially from the figure of its penultimate stage in *R. temporaria* or *R. agilis* figured by Thiele[3] in his paper on the "Der Haftapparat der

[1] Butler, *Journ. Bombay Nat. Hist. Soc.* XV, p. 391.
[2] Smith, *Journ. Nat. Hist Soc. Siam*, II, p. 40, pl.—, figs. B1-B3.
[3] Thiele. *Zeitsch. wiss Zool.* XLVI, p. 75, pl. x, fig. 6 (1888).

Batrachierlarven,'' except that the tips of the two papillae are more prominent and differentiated in colour.

At this stage of the tadpole of *K. pulchra* there is a broad and prominent fleshy crest on the surface of the head. I do not understand the lines shown crossing the head in Smith's figure (B2); there are certainly no transverse groove or rows of glands in the position indicated.

Development is very rapid, and though doubtless accelerated or retarded by favourable or unfavourable conditions, probably does not take longer in ordinary circumstances than about a week. I figure three stages of the larva at 24, 36 and 72 hours after hatching. It should be noted that the younger tadpoles are more highly magnified than the older ones. These tadpoles were reared in a small bowl of water and development would probably have been more rapid in normal conditions.

Bufo parvus, Boulenger.

(Plate VI, fig. 8).

1912. *Bufo parvus*, Boulenger, *op. cit.*, p. 274.

LARVA.

1916. *Bufo parvus*, Smith, *op. cit.*, p. 42, pl.—, figs.

This tadpole also has just been described by Smith. It closely resembles that of *Bufo melanostictus*, but can be distinguished readily by the fact that the second row of teeth on the upper lip is continuous or but very slightly interrupted in the middle line. The whole animal is also stouter and the tail considerably deeper.

FIG. 10.—Tadpole of *Bufo parvus*. Mouth-disc (× 12).

I found a large number of specimens, with those of *Rana labialis*, in a small pool at the base of the Taiping hills in February, 1916.

Measurements:—

Length of body	10 mm.
Breadth of body	5 ,,
Length of tail	18 ,,
Depth of tail	4 ,,

Megalophrys hasseltii (Tschudi).

(Plate VI, figs. 8, 9).

1912. *Megalophrys hasseltii*, Boulenger, *op. cit.*, p. 282.

LARVA.

1890. *Leptobrachium hasseltii*, *id.*, *Proc. Zool. Soc. London*, p. 37.
1907. *Leptobrachium hasseltii?*, van Kampen, in Weber's *Zool. Ergebn. Ost.-Ind.* IV, p. 408.
1909. *Megalophrys hasselti*, *id.*, *Natuurk. Tijdsch. Ned.-Ind.* LXIX, p. 27, pl. ii, fig. 1.

The tadpole of this species appears to be very variable in colouration and proportions; the number of interrupted rows of teeth on the lower lip may be either 4 or 5. The variation in colour is perhaps due to local causes. I have specimens of three colour-varieties before me; they differ as follows:—

(*A*) The whole of the head, body and tail is profusely marked with small round black spots not more than a millimetre in diameter.

(*B*) The whole animal is of a pale brown colour with a relatively small number of large black spots and blotches, as a rule of irregular shape, on the dorsal and lateral surfaces.

(*C*) The colour is practically uniform, without dark spots or blotches.

The first of these colour-forms seems to be common in the Malay Peninsula, where it has been found at Ipoh in Perak and at the base of Bukit Besar in the Siamese Province of Patani. I have received a specimen from Perak in exchange with the British Museum. Van Kampen records somewhat similar specimens, but with the ventral surface white, from Sumatra. The second form is common in jungle-streams on the Dawna Hills in Tenasserim, while the third was described by van Kampen from Java. He has been kind enough to send me specimens.

It is possible that these three forms actually represent distinct species, but this seems to be improbable. The variation in proportions is not correlated with geographical records, and in specimens from the Dawna Hills I found that the tail was frequently shortened by injury, and that it was not always clear, when the wound had healed, to what extent the proportions had been changed.

The specimens obtained by Mr. Robinson and myself at the base of Bukit Besar in 1901 were living in a fairly deep pool in a small stream in open country, and were observed to rise to the surface from time to time, while in the Dawna Hills Dr. Gravely and I found, on separate occasions, the form with large spots common under stones in very small rapid streams in rather dense jungle. Dr. van Kampen's specimens from Java were found in clear rapid-running brooks. As van Kampen has pointed out, the mouth-parts of this larva do not differ materially from those of the European species of *Pelobates* as figured by Boulenger. It is all the more remarkable, therefore, that in the Dawna Hills we found in the same part of the same streams a species of *Megalophrys*-larva in which the mouth had the peculiar funnel-like structure of that of *M. montana* and other species of the genus.

Megalophrys montana, Kuhl.

(Plate VI, figs. 10).

1912. *Megalophrys montana*, Boulenger, *op. cit.*, p. 277.

LARVA.

1912. *Megalophrys montana*, Annandale, *Rec. Ind. Mus.* VIII, p. 30, fig. 1.

Measurements:—

Length of body	11 mm.
Breadth of body	5·5 ,,
Length of tail	22 ,,
Depth of tail	6 ,,

Further references to this and other similar tadpoles of the genus will be found on p. 28 of the paper cited under my name. I am now acquainted with at least five larvae of this type, from the Himalayan foot-hills, Burma, the Malay Peninsula and Hongkong. They are all very similar in structure and habits, but may perhaps be distinguished by the characters noted below.

? **Megalophrys boettgeri** (Boulenger).

Plate VI, fig. 11.

1899. *Leptobrachium boettgeri*, Boulenger, *Proc. Zool. Soc. London*, p. 171, pl. xix, fig. 3.
1908. *Megalophrys boettgeri*, Boulenger, *Proc. Zool. Soc. London*, I, p. 420.
? 1912. *Megalophrys kempii*, Annandale, *Rec. Ind. Mus.* VIII, p. 20, pl. iii, fig. 5.

LARVA.

? 1912. *Megalophrys*, sp., Annandale, *op. cit.*, pl. iv, fig. 10.

I am doubtful whether my *M. kempii* from the Abor country is really distinct from Boulenger's *M. boettgeri* from South China. The only difference likely to be constant is that in the Abor form the tongue is distinctly notched, whereas it is described in the Chinese species as being entire. I have had no opportunity to compare specimens.

In small streams on the Peak at Hongkong, I found a number of tadpoles of the genus which I am unable to distinguish from an unidentified tadpole from the Abor country. They were abundant both in September and December, 1915, but in neither month was I able to find individuals with well-developed limbs.

Measurements:—

Length of body	10·5 mm.
Breadth of body	6 ,,
Length of tail	26 ,,
Depth of tail	5·5 ,,

KEY TO CERTAIN TADPOLES OF THE GENUS MEGALOPHRYS.

I. Tail nearly 3 times as long as head and body, at least 5 times as long as deep. Upper and lower profiles of tail, for the proximal $\frac{2}{3}$, nearly parallel, straight; dark markings if present minute; ventral surface pigmented .. *M. major.*

II. Tail not more than $2\frac{1}{2}$ times as long as head and body.
  - A. Tail at least 5 times as long as deep, tapering gradually and evenly to a very sharp point; sides mottled and spotted; ventral surface pigmented .. .. *M. montana.*
  - B. Tail not more than $4\frac{1}{2}$ times as long as deep.
    1. Ventral surface white, at most with small spots, dorsal profile of tail arched posteriorly .. .. .. *M. parva.*
    2. Ventral surface pigmented.
       (a) Dorsal profile of tail distinctly sinuous: sides conspicuously spotted or blotched .. .. .. *M. robusta.*
       (b) Dorsal profile of tail straight almost to the tip: sides practically immaculate .. .. .. ? *M. boettgeri.*

EXPLANATION OF PLATE V.

Rana tigrina, *R. limnocharis* AND ALLIED FORMS.

Rana tigrina, Daudin.

FIGS. 1, *1a*, *1b*.—Head of an adult male from Calcutta ($\times \frac{2}{3}$).
,, 2, *2a*.—Head of young frog from Calcutta (nat. size).

Rana rugulosa, Wiegmann.

,, 3, *3a*, *3b*.—Head of adult male from Koh Samui, Siam ($\times \frac{2}{3}$).

Rana cancrivora, Gravenhorst.

,, 4, *4a*, *4b*.—Head of adult female from Singgora, Peninsular Siam ($\times \frac{2}{3}$).

Rana wasl, sp. nov.

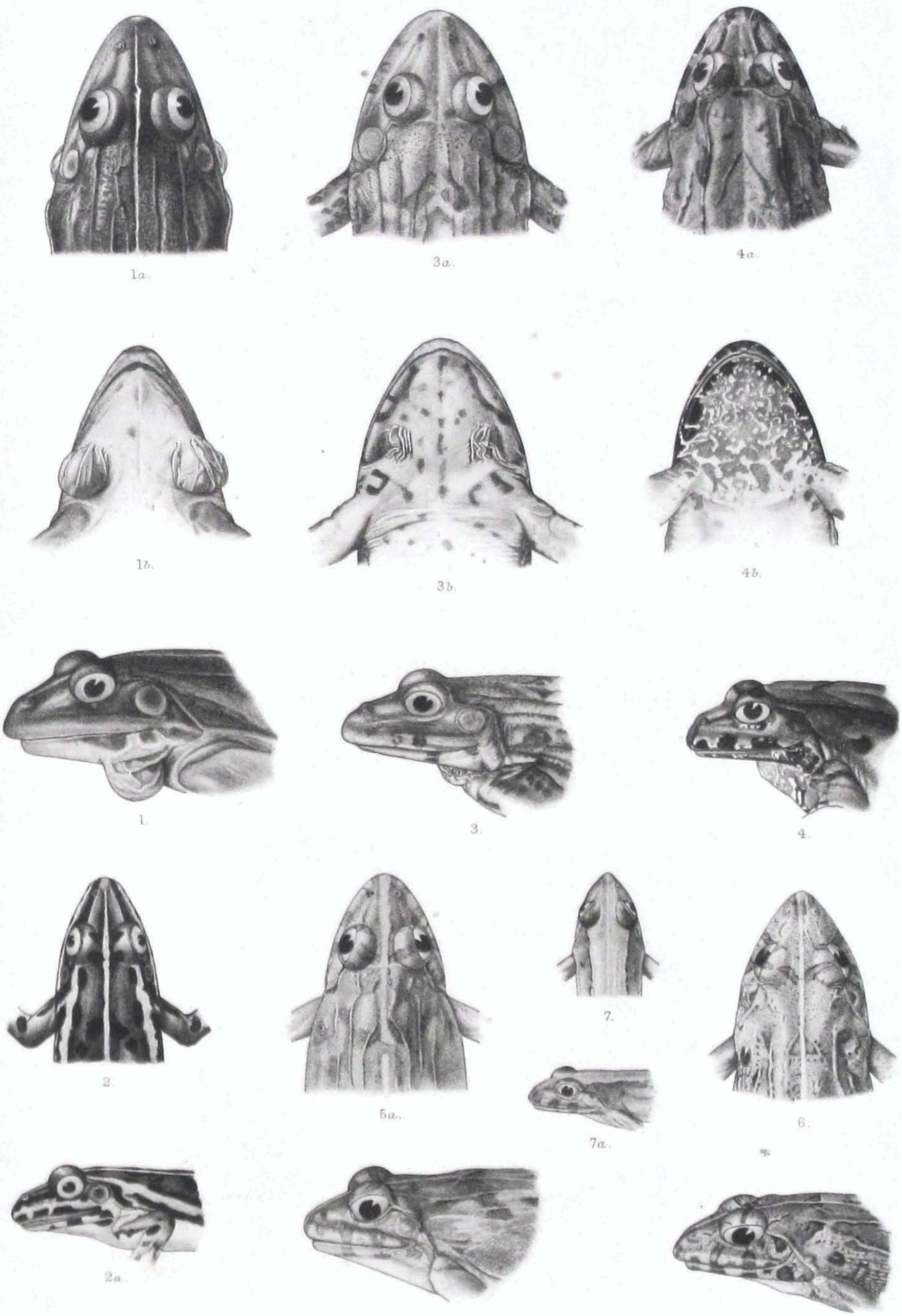
,, 5, *5a*.—Head of type-specimen (adult female) from Sarawak (nat. size).

Rana limnocharis, Wiegmann.

,, 6, *6a*.—Head of adult female of typical form from Java (nat. size).

Rana limnocharis var. **andamanensis** (Stoliczka).

,, 7, *7a*.—Head of adult female from Baratang Island, Andamans (nat. size).


1a.
3a.
4a.
1b.
3b.
4b.
1.
3.
4.
2.
5a.
7.
7a.
6.
2a.

EXPLANATION OF PLATE VI.

TADPOLES OF EASTERN ASIA.

Rana tigrina, Daudin.

FIGS. 1, *1a*.—Two tadpoles of the same age from Calcutta (× 2).
Showing variation in the position of the nostril and in the outline of the tail.

Rana limnocharis, Wiegmann.

FIG. 2.—Tadpole from Madras (× 2).

? **Rana brevipalmata**, Peters.

,, 3.—Tadpole from Cochin (× 2).

? **Rana nigromaculata**, Hallowell.

,, 4.—Tadpole from Lake Kasumi-ga-Ura, Japan (× 2).

Rana labialis, Boulenger.

,, 5.—Tadpole from near Taiping, Perak (× 2).

Microhyla achatina (Boie).

,, 6.—Tadpole from Penang (× 3).

Kaloula pulchra, Gray.

,, 7.—Tadpole hatched about 24 hours, from Singapore (× 16).
,, *7a*.—Tadpole from the same batch 36 hours old (× 12).
,, *7b*.—Tadpole from the same batch 72 hours old (× 4).

Bufo parvus, Boulenger.

,, 8.—Tadpole from near Taiping, Perak (× 3).

Megalophrys hasseltii (Tschudi).

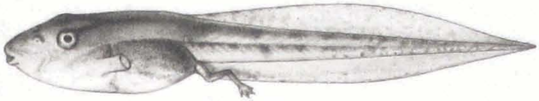
,, 9.—Tadpole from the Dawna Hills, Tenasserim (nat. size).

Megalophrys montana, Kuhl.

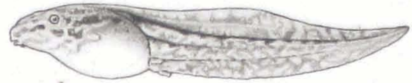
,, 10.—Tadpole from Penang Hill (× 3).

? **Megalophrys boettgeri**, Boulenger.

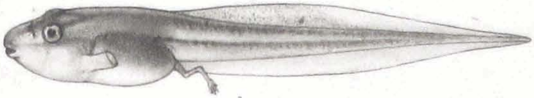
,, 11.—Tadpole from the Peak, Hongkong (× 3).



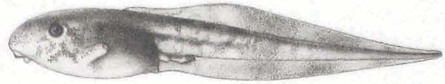
1 × 2.



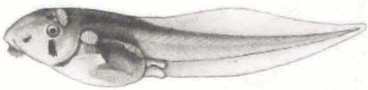
3 × 2.



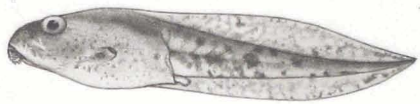
1*a* × 2.



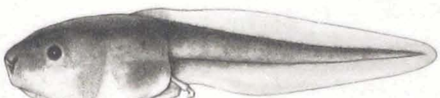
2 × 2.



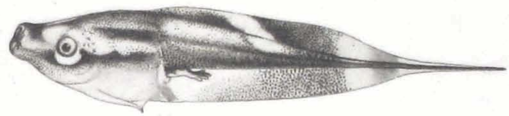
5 × 2.



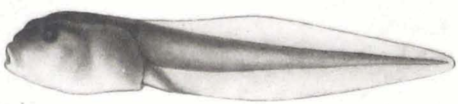
4 × 2.



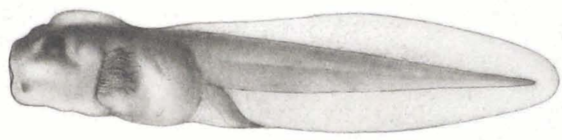
7*b* × 4.



6 × 3.

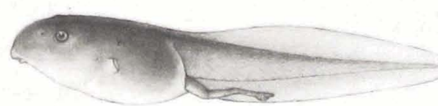


7*a* × 12.



7 × 16.

11 × 3.



8 × 3.

MEMOIRS

OF THE

ASIATIC SOCIETY OF BENGAL

VOL. VI, pp. 157—182.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

EDITED BY N. ANNANDALE, D.Sc., F.A.S.B.

PART III.

CALCUTTA:
PRINTED AT THE BAPTIST MISSION PRESS, AND PUBLISHED BY
THE ASIATIC SOCIETY, 1, PARK STREET.
1917.

Price Re. 1·8; or 2*s.* 3*d.*

20-10-17.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

PART III.

CONTENTS.

Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

HIRUDINEA.

By DR. ASAJIRO OKA.

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

HIRUDINEA.

By DR. ASAJIRO OKA, TOKYO.

(With Plate VII.)

The collection of leeches made by Dr. N. Annandale during his trip to Japan, China and Siam, in 1915 and 1916, was placed in my hands for determination. I heartily thank Dr. Annandale for allowing me the privilege of examining the specimens, some of which proved unusually interesting.

The material contains fourteen species arranged in ten genera, representing all the four families into which the non-chaetiferous leeches are now divided. They are mostly known forms previously described from Japan or China, only three of the species being new to science. Two of the latter, however, are such peculiar forms that it was found necessary to establish a new genus for each. One of these, *Ancyrobdella biwae*, n. g., n.sp., is a curious little Glossiphonid, much resembling an Ichthyobdellid in external appearance. It was taken from the bottom of Lake Biwa at a depth of 260 Japanese feet (about 80 meters), and is characterised by the presence of three comparatively large hooks near the tip of an extraordinarily long proboscis. The other one, *Myxobdella annandalei*, n. g., n.sp., is a strange-looking Hirudinid with exceptionally soft body, collected in a small streamlet on the Peak, Hong Kong, about 1000 feet high, and is readily distinguished by the unique character that the furrows separating the somites are decidedly deeper and much more conspicuous than those separating the annuli. The third new species, a *Hemiclepsis* from Siam, is interesting in so far as it occupies a position intermediate between that genus and *Placobdella*.

With regard to the generic names of leeches, it should be remarked that a large number of genera now recognized are based solely upon external characters without any regard to internal structure, so that they require a thorough revision when their anatomy has been sufficiently worked out. My own studies on Japanese leeches convince me that such a revision would necessarily result in the suppression of numerous old genera and the formation of no less new ones, with the corresponding rearrangement of the species. In the present paper, however, I have intentionally abstained from making any such attempt and have employed the generic designations simply as they are now used. It might perhaps be noticed here that the discrimination of such genera as *Placobdella*, Blanchard (1893), *Mimobdella*, Blanchard (1897), and *Scaptobdella*, Blanchard (1897), from their nearest allies is, in certain cases, a matter of great difficulty, if not of impossibility.

The following is a classified list of genera and species represented in the collection :--

HIRUDINIDAE.

Whitmania laevis.
Whi. edentula.
Myxobdella annandalei, n. g., n. sp.

HERPOBDELLIDAE.

Herpobdella testacea.
Mimobdella japonica.
Scaptobdella blanchardi.

GLOSSIPHONIDAE.

Glossiphonia smaragdina.
Gl. lata.
Placobdella rugosa.
Hemiclepsis marginata.
Hemiclepsis casmiana.
H. siamensis, n. sp.
Ancyrobdella biwae, n. g., n. sp.

ICHTHYOBDELLIDAE.

Ozobranchus jantseanus.

Fam. HIRUDINIDAE.

1. Whitmania laevis (Baird).

Syn. *Hirudo laevis*, Baird (1869).

Leptostoma pigrum, Whitman (1886).

Whitmania pigra, Blanchard (1887).

Locality. Tong-Dong-Ding creek, Tai-Hu; Dec. 5th, 1915. Two specimens.

Both examples are large and of nearly the same size, measuring about 120 mm. in length and 25 mm. in width. They slightly vary in details of marking, one being more profusely mottled with black on the ventral side than the other, which in turn is somewhat darker ventrally than most of the Japanese specimens; otherwise they agree quite well with the original description of the species.

2. Whitmania edentula (Whitman).

Syn. *Leptostoma edentulum*, Whitman (1886).

Locality. Si-Dong-Ding, Tai-Hu. Dec., 1915. One specimen.

The single specimen is about 39 mm. long and 9 mm. wide, and shows most clearly the extremely attenuated shape of the head region characteristic of the species. It differs, however, from most of the Japanese specimens in that the lateral yellowish bands of the dorsal surface, of which there are two on each side, are nearly as distinct as the median one throughout the whole length of the body. In Japanese examples the former are mostly very faint except near the anterior and posterior extremities, so that at first sight the animal appears to have only the median band.

A comparison of a large series of specimens from Japan and China in my own collection shows that the present species is somewhat variable in this respect, the extremes being represented by the usual Japanese form with only one longtitudinal band, and the Chinese form with five longitudinal bands of almost equal breadth which I have provisionally named var. *sinica* in my collection. The present specimen belongs to the latter group. A specimen from near Tateyama Bay, in the possession of the British Museum and figured by Blanchard in his paper on Asiatic leeches (1896), exhibits a condition just intermediate, the lateral bands being here sufficiently distinct but markedly narrower than the median one. The dark spots on the ventral surface are also variable, being much less numerous in the present specimen than in most of the Japanese examples.

3. **Myxobdella**[1] **annandalei**, n. g., n. sp.

Plate VII, figs. 1—5.

There are in the collection three specimens of this very interesting leech. It is allied in many respects to the well-known genus *Haemopis* (*Aulastoma*), but differs from this, as well as from all other genera, in having the somites distinctly bounded externally. This is certainly a rare exception among the Hirudinea, in which the metameric structure is, as a rule, completely obliterated by the formation of secondary furrows looking exactly like those separating the somites. As is well known, the fixing of somite-limits has long been the subject of debate and an artificial method of plotting out the somites by assuming the segmental sensillae to be on the first annulus was universally adopted until as late as 1900, when Castle's important paper on the metamerism of the Hirudinea appeared, in which the author pointed out the inadequacy of this procedure. Were the present form known at the time of Gratiolet (1862), there would have been obviously no discussion about, and no false determination of, the somite-boundaries in this group of annelids.

The study of this leech was greatly facilitated by a number of additional examples sent to me by Prof. H. E. Earle, of Hong Kong University, who collected them at my request at the same locality as Dr. Annandale found his specimens. I wish here to express my cordial thanks to Prof. Earle for his kindness in obtaining for me the valuable material.

Shape and Dimensions. All three of the specimens are a good deal contracted. They are of nearly the same size, the length measured along the curved dorsum being 26-29 mm. and the greatest width about 9 mm. The shape of the body is much like that of a *Haemopis* in a contracted state, only with the head end somewhat narrower. Both extremities are bent downwards, especially the posterior, so that the hinder sucker is entirely hidden when the animal is viewed from above. Toward the anterior end the body tapers gradually and ends in the anterior lip of the small oral sucker, which is not marked off from the adjoining region. The dorsal surface is convex throughout, while the ventral side is slightly concave in the greater part of the length.

[1] *μυξα* mucus, *βδελλα* leech.

The thickness of the body at the thickest part is 4·5 mm. The posterior sucker is circular in outline, about 6 mm. in diameter, and not very deep; it is connected with the trunk much in the same way as in the ordinary medicinal leech.

External Characters. Undoubtedly the most conspicuous of the external features of this leech is that the body is divided by deep furrows into distinctly bounded somites, each of which is subdivided into annuli by much shallower ones. This is evident both on the dorsal and ventral surface, but more so on the ventral, where the furrows have been made still deeper in consequence of the curvature of the body. In fact, when the animal is seen from this side, the furrows marking the boundaries of somites appear so conspicuous that all others look like mere wrinklings (pl. vii, fig. 5).

The skin is on the whole smooth, there being neither papillae nor tubercles to roughen the surface. The segmental sensillae, so constant and regularly arranged in many Hirudinids, could not be detected externally, though such organs were observed here and there in sections.

The colour of the specimens preserved in alcohol is a uniform ash-grey without any trace of pattern or streaks. One individual which was somewhat darker than the others was found under a dissecting lens to be mottled all over with minute dots of a darker tint.

The details of annulation of one of Dr. Annandale's specimens are exhibited in pl. vii, figs. 1 and 2. As stated above, no difficulty is experienced in determining the boundaries of somites, which are very distinct externally. Even near the anterior and posterior extremities, where the somites are shorter and have less number of annuli than in the middle region, the limits are quite obvious. The counting of the annuli is, on the other hand, not so easy, as some of the furrows separating them are found on the dorsal side or at the lateral margins only, so that we have different number of annuli according to how and where we count them.

Counted on the dorsal side there are about 108 annuli in front of the posterior sucker. They are grouped into twenty-seven somites as follows:—

Somites.	*No. of annuli.*
I, II, III	1
IV, V	2
VI, VII	3
VIII, IX	4
X—XXI	5
XXII, XXIII	4
XXIV, XXV	3
XXVI	2
XXVII	1

On the ventral side some of the typical five-ringed somites appear to have one ring less, the first annulus, which is very narrow, being hidden in the deep furrow immediately in front of it. Thus, in fig. 3 somites XI and XII are represented as consisting of four rings only. Where two consecutive somites have the same reduced number of annuli, the one further removed from the middle exhibits always a condition approaching the next stage of reduction. For instance, of the somites IV and V the latter is more decidedly biannulate, whereas in IV the furrow separating the annuli is rather faintly developed. VIII and X have likewise one annulus less on the ventral side, the first and second being fused here except at the margins. Our leech shows, thus, a perfect series of gradations between the uniannulate condition at the extremities and the typical quinqueannulate somites in the middle part of the body.

There are five pairs of eyes situated exactly like those of *Hirudo* or *Haemopis*, i.e. a pair each on the 2nd, 3rd, 4th, 6th and 9th ring. The second pair is the largest. They all lie rather deep beneath the surface, so that they could be detected only after clarifying in oil.

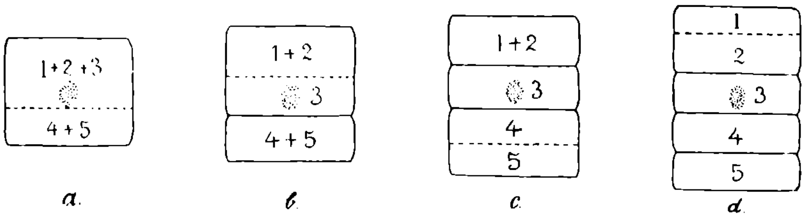
The configuration of the oral sucker is somewhat peculiar (pl. vii, fig. 3). It is a small cup-shaped deepening on the ventral side of the head, and is bounded posteriorly by a double ring corresponding to the 6th and 7th annuli on the dorsal surface. From the bottom of this deepening, near its posterior end, is seen projecting a short papilla-like elevation, upon the summit of which the tiny mouth-opening is situated. In preserved specimens this structure is more or less flattened and looks somewhat like a miniature tongue. The mouth itself is distinctly three-rayed, being composed of a dorso-median and two ventro-lateral slits meeting at the centre. As there is no Gnathobdellid in which the oral sucker shows such a structure, it would be very interesting to investigate the use of this organ in life. Possibly it might represent a sucking apparatus in primitive condition, which, when further developed, would lead to the formation of the tubular proboscis so characteristic of the Rhynchobdellida.

The genital openings correspond in position exactly to those of *Hirudo*, i.e. the male opening lies between the 4th and 5th rings of somite XI, and the female between the 4th and 5th rings of somite XII. They are both quite inconspicuous, there being no special elevation or glandular area to indicate their position. In all three of Dr. Annandale's specimens the clitelium was not developed, although they were all mature as judged from the condition of the genital glands of one dissected. One of Prof. Earle's specimens showed it tolerably well; it extends, as in *Hirudo*, from the third ring of somite X to the second ring of somite XIII, both inclusive.

The nephridial pores could not be detected externally in Dr. Annandale's specimens, but in some of Prof. Earle's examples the position of these opening was indicated by the local widenings of the furrows containing them. There are in all seventeen pairs, as in *Hirudo*, the pores being situated in the furrow separating the 2nd and 3rd rings of somites VIII—XXIV.

The posterior sucker is attached to the ventral side of somites XXII-XXVII. The anus is located on the dorsal surface of the sucker in a slight transverse furrow just behind the last annulus of the trunk.

It is very interesting to notice that in our leech the furrows separating the annuli of a typical somite are not of equal depth, as in all other genera, but form a regular set of four different depths. The deepest furrow is always the one separating the third and fourth annuli, the next deepest the one separating the second and third annuli. Then comes the furrow between the fourth and fifth annuli, while that between the first and second is invariably the shallowest of all. When we trace the somites from the middle region towards both extremities it is always the shallowest furrow, i.e. the one separating the first and second annuli, that disappears first, while the deepest one, that between the third and fourth, continues to exist so long as the somite is at all subdivided into annuli. From this we might safely infer that when a somite is biannulate the rings represent 1+2+3 and 4+5 of the typical quinqueannulate somite respectively (*a*). Similarly, in a triannulate somite the rings are 1+2, 3 and 4+5 (*b*); in a quadriannulate somite they are 1+2, 3, 4 and 5 (*c*).



Diagrams showing stages in the formation of quinqueannulate somite in Hirudinea. (Dotted area indicates the position of nerve-ganglion).

This agrees remarkably well with the result obtained from a comparative study of Japanese leeches, which I read at a meeting of the Tokyo Zoological Society several years ago. As I hope to deal with the subject more fully elsewhere, I confine myself here to state that our new genus with its unique character throws considerable light not only on the external morphology of the Gnathobdellids but of the Hirudinea in general.

Internal Anatomy. The alimentary tract resembles, on the whole, that of *Haemopis*, the only considerable difference being in the size of the jaws. These are very small, only about 0·2 mm. in diameter, and are provided each with two rows of three or four minute denticles along the middle part of the margin. In sections a bundle of ducts of unicellular glands is seen opening on the edge of each jaw.

The stomach, including the lateral sacculations, was found completely filled with a very hard homogeneous mass of a brownish colour, which became opaque white when placed in water. No solid particles, such as residue of aquatic worms, setae, cuticle, etc., were detected in it. I am inclined, therefore, to believe that our leech lives by sucking blood of invertebrate animals.

So far as I could count, there are eight pairs of testes, each placed behind and somewhat beneath the lateral sacculation of the stomach. The vas deferens forms a considerable mass of convolutions on each side of the male pore. The female organ seems to correspond in structure to that of *Haemopis*.

Locality. Small streamlet on the Peak, Hong Kong, ca. 1000 ft. Dec. 15, 1915.

Three specimens. "Body exceptionally soft. Enormous quantities of mucus produced. Adhering to lower surface of stones."

Systematic Position. In spite of the peculiar external appearance this leech belongs undoubtedly to the distichodont division of the family Hirudinidae, as shown by the presence of two rows of teeth on each jaw. It is closely allied to the genera *Haemopis* and *Semiscolex*, and forms together with these a well-defined group. The three genera may be distinguished as follows:—

Furrows all alike, jaws with about 30 teeth	..	*Haemopis.*
,, ,, no jaws	..	*Semiscolex.*
Furrows unlike, jaws rudimentary ..	..	*Myxobdella.*

It is noteworthy that in specimens of *Semiscolex variabilis* from Southern Patagonia studied by Percy Moore (1913) the furrows separating the annuli in a somite are of different depths so long as the animal is young, but the inequality disappears when it is full grown. Here too, as in *Myxobdella*, the deepest furrow is that between the third and fourth annuli, so that there are formed two natural groups of annuli, consisting of 1, 2 and 3, and 4 and 5 respectively. If carefully examined when young, a similar condition might also be found in some other genera.

In the rudimentary condition of the jaws our leech exhibits certain affinity with the African genus *Trematobdella*, which, according to the investigations of Johansson (1909, 1914) carries rudimentary teeth in a position corresponding to the jaws of the Hirudinids. In other respects, however, this genus shows all the essential characters of Herpodellidae, including the so-called pseudognaths, not found in other families.

Fam. HERPOBDELLIDAE.

4. **Herpobdella testacea** (Savigny).

Syn. *Nephelis testacea*, Savigny, 1820.

Nephelis vulgaris, Moquin-Tandon, 1826, partim.

Herpobdella octoculata, Blanchard, 1894.

Locality. Komatsu, Lake Biwa, ca. 30 ft. Oct. 27, 1915. One specimen. "On external surface of living *Corbicula* shell. *Colour.* Dark, dull purplish grey, paler towards extremities."

This is a very small immature specimen, measuring only 13 mm. in length and 1·5 mm. in width. It has only six eyes instead of eight, the middle ones of the second row being absent.

In the identification of this species I have followed Johansson (1910) who states that the form commonly known under the name of *H. octoculata* is in reality *H. testacea* of Savigny.

It may be noticed here that this is the less abundant of the two species of *Herpobdella* found in Japan, the other one, *H. octoculata*, Linné (*H. atomaria*, Blanchard, 1894) being by far the commonest of all the freshwater leeches of this country.

5. **Mimobdella japonica**, Blanchard (1897).

Locality. Komatsu, Lake Biwa, 30-100 ft. Oct. 27, 1915. One specimen "Among *Corbicula*. *Colour*. Dark purple-brown, with indistinct cross bars on dorsal surface."

The single specimen measures about 40 mm. in an extended condition, and is apparently immature.

As the original description of this species given by Blanchard was based upon a very old specimen collected by Siebold, and is naturally somewhat imperfect, I take here the opportunity of supplementing it with a few remarks.

The colour in life is greenish, reddish or purple-brown, with indistinct pattern of darker tint on the dorsal surface, pale reddish ventrally.

There is a pair of eyes on the second ring placed rather wide apart. When mounted in glycerine, four minute pigment dots or rudimentary eyes become visible on the fifth ring, which are evidently homologous with the posterior row of eyes of *Herpobdella*.

Each typical somite consists of three large and four small rings. From the position of the nervous ganglion, which lies within one of the larger annuli, it seems very probable that the three large rings are the second, third and fourth annuli of the originally five-ringed somite, and the four small rings correspond to the first and fifth annuli each subdivided into two. Sometimes the second and fourth rings also show indications of subdivision, in which case the somite appears as nine-ringed, as given by Blanchard.

The male genital aperture lies in the furrow separating somites XI and XII, the female between the fifth and sixth ring of somite XII. Thus, the pores are separated by a space corresponding to four annuli of the typical five-ringed somite.

The clitellum includes twenty-one rings, beginning with the fifth ring of somite X and ending with the fourth ring of somite XIII, both inclusive. It will be seen by comparison that the extent of the clitellum agrees exactly with that of an ordinary *Herpobdella*.

6. **Scaptobdella blanchardi**, Oka (1910).

Localities. (1) Zeze, under stones near edge of Lake Biwa. Oct. 3, 1915. Six specimens. (2) Sta. 13, lower surface of stones at shore of Chikubushima. Oct. 1-3, 1915. One specimen.

These are all small specimens, the largest measuring only 32 mm. in length and 4 mm. in width. They are of a pale greyish colour, and differ in no wise from individuals of similar size from other localities.

Fam. GLOSSIPHONIDAE.

7. **Glossiphonia smaragdina**, Oka (1910).

Locality. Sta. 13, lower surface of stones at shore of Chikubushima. Oct. 1-3, 1915. One specimen.

The single specimen is rather small, not much contracted; in life it was of a beautiful green colour characteristic of the species.

8. **Glossiphonia lata,** Oka (1910).

Locality. Sta. 13, lower surface of stones at shore of Chikubushima. Oct. 1-3, 1915. Nine specimens.

All are much contracted, being pear-shaped or almost circular in outline. The largest specimen measures 6 mm. in length and 5 mm. in width.

9. **Placobdella rugosa** (Verrill).

Syn. *Clepsine ornata* var. *rugosa*, Verrill, 1874.

Placobdella rugosa, Moor, 1901.

Locality. Zeze, under stones near edge of Lake Biwa. Oct. 3, 1915. One specimen.

The single specimen is 17 mm. long and 9 mm. wide. The number and position of the dorsal papillae agree tolerably well with the figures of this species given by Moore in his report on the leeches of Minnesota (1912). His description of the colour and markings of the living animal applies on the whole, equally well to the present specimen.

10. **Hemiclepsis marginata** (O. F. Müller).

Syn. *Hirudo marginata*, O. F. Müller, 1774.

Glossiphonia marginata, Moquin-Tandon, 1846.

Locality. Near Soochow, Tong-Dong-Ding, Tai-Hu. Dec. 4, 1915. Four specimens.

The largest specimen measures 12·5 mm. in length and 5 mm. in width, others are somewhat smaller. They were found parasitic on the tortoise *Damonia reevesii*.

11. **Hemiclepsis casmiana,** Oka (1910).

Localities. (1) Komatsu, Lake Biwa, "in shell of *Anodonta*." Oct. 23, 1915. Seven specimens. (2) Tai-Hu, "in *Anodonta woodiana* and *Nodularia douglasiae*." Dec. 1, 1915. About twenty specimens.

Both Japanese and Chinese specimens are mostly small and immature. Only one example from Komatsu is full grown, and measures 13 mm. in length and 5 mm. in width.

12. **Hemiclepsis siamensis,** n. sp.

Plate VII, figs. 6—8.

Shape and Dimensions. The general shape of the body is like that of *H. marginata*, being rather long and narrow even in contracted condition, but the head is not perceptibly broader than the neck. The dorsal surface is strongly convex and the ventral concave, so that in cross section the body is crescentic in outline. The margins are sharply serrated. The largest specimens measure about 15 mm. in length and 4 mm.

in width. Most of the larger individuals carry numerous young attached to the ventral surface of the body.

External Characters. The dorsal surface is quite rough all over, owing to the presence of numerous well developed conical papillae. These are of various sizes and form a transverse row of 22-27 on every ring. There seems, however, to be no regularity as to their arrangement longitudinally, so that no well-defined longitudinal rows are formed, such as are characteristic of many species of *Glossiphonia* and *Placobdella*. Even the papillae lying about the median line do not form a regular row, some being placed a little to the right and some a little to the left. In each transverse row the papillae are arranged, as a rule, symmetrically, those of the same size occupying corresponding position on both sides of the median line. Posterior to the genital orifices every third annulus has smaller and more numerous papillae than the intervening ones. This is most striking in a few somites in front of the posterior sucker, where the annuli bearing smaller papillae are less than half so broad as those preceding or succeeding them (pl. vii, fig. 7). The ventral surface is entirely smooth.

The colour in alcohol is a uniform grey, with a faint brownish streak along the median line of the dorsal surface. On the ventral side it is much paler. Many of the specimens have the lateral margins dotted with brown.

Somites I—III are uniannulate, IV and V are biannulate, each being divided into a larger anterior and a smaller posterior annulus (pl. vii, fig. 8). Nineteen somites, VI—XXIV, are triannulate. The three remaining somites, XXV—XXVII, are uniannulate, and are much narrower transversely than the preceding ones (pl. vii, fig. 7). The total number of annuli is, accordingly, sixty-seven. As shown in the figure, the typical somite consists of three annuli of approximately equal size, the middle one of which bears markedly smaller papillae than the other two (pl. vii, fig. 6). In somites XXIII and XXIV the second annulus is itself very small and carries only minute papillae. As there is no biannulate somite in the posterior region, the transition from the triannulate to uniannulate somite is rather abrupt, causing the last three rings to appear like the peduncle of the sucker.

There is apparently a single pair of eyes placed close together in the anterior part of the third annulus. As they are rather large it is possible that each represents two eyes belonging to two consecutive rings fused together.

The oral sucker has the usual shape and is rather large, measuring nearly 1·5 mm. across. It occupies the ventral side of the annuli 1-5. The annuli 6 and 7 are fused on the ventral side and form the posterior boundary of the sucker. The mouth opening is placed on the lower surface of the anterior lip a little distance from the margin.

The male genital orifice lies between the annuli 25 and 26, i.e. between somites XI and XII. The female pore is situated between the annuli 27 and 28, i.e. between the second and third ring of somite XII.

I was unable to find a well defined clitellum in any of the specimens, nor could I detect the external openings of the nephridia.

The posterior sucker is cup-shaped as usual, and measures about 2·5 mm. in diameter. It is attached to the ventral side of the last three rings. The anus is placed on the dorsal surface of the hinder sucker immediately behind the last annulus.

Internal Anatomy. The mouth leads into the usual pharyngeal sac which extends backwards into about somite IX. In it lies the tubular proboscis, into the posterior end of which opens on each side a bundle of unicellular salivary glands. Then follows the stomach produced laterally into seven pairs of coeca, the last of which passes backwards through about fourth somite and ends in somite XXIV. The shape of the coeca is like those of *Hemiclepsis marginata*, but in quite small specimens the first six are simple, only the last showing ramifications corresponding to the somites. The intestine is produced as usual into four pairs of simple pouches, all enveloped in a sac-like dilatation of the dorsal blood vessel.

The nephridia were not traced out fully, nor was the total number counted; the ciliated funnels were found to possess a form characteristic of the family.

As to the generative organs I have nothing particular to mention. Both the male and female apparatus show, so far as I could make out, the same structure as those of *H. marginata*.

Locality. Lampam, Patalung, Siam. Jan. 15, 1916. Numerous specimens. "Parasitic on the tortoise *Bellia crassicollis*."

Systematic Position. I place this species in the genus *Hemiclepsis* on account of its great resemblance in structure to *H. marginata*, the type of the genus. It is also closely allied to the genus *Placobdella*, with which it agrees in almost all of the diagnostic characters. In fact, the number of eyes and the position of the mouth-opening point rather toward a closer affinity with the latter, but the general shape of the body and especially that of the comparatively large oral sucker speak in favour of its inclusion in the former. The difference in the number of eyes can not be looked upon as very important, as in the genus *Placobdella* the eyes are compound, as they probably are in the present species. The presence of numerous papillae, the position of the genital orifices separated by two annuli, the number and form of the gastric coeca, even the parasitic mode of life with the tortoise as host are the same in both genera. If we except, therefore, the number of eyes, the only distinctive characters would be the position of mouth for *Placobdella* and the shape of the head for *Hemiclepsis*. Now, the present species combines both these characters, though not very distinctly: the mouth opening is not at the margin of the anterior lip, but a short distance behind it, nor is the head region so markedly widened as in *Hemiclepsis marginata*, but only very slightly. Such being the case, I have thought best to regard it as a member of the genus *Hemiclepsis* occupying a position on the border between this genus and *Placobdella*.

13. **Ancyrobdella**[1] **biwae**, n.g., n.sp.

Plate VII, figs. 9—12.

This is no doubt the most remarkable leech contained in the collection. It is interesting not only on account of its extraordinary characters, but also because it is

[1] ανχυζα anchor, βδελλα leech.

the only representative of the Hirudinea hitherto recorded from the bottom of a deep fresh-water lake of Japan.

Shape and Dimensions. In external appearance this leech looks much more like an Ichthyobdellid than a Glossiphonid (pl. vii, fig. 11). The body is very slender, only slightly depressed, and almost cylindrical in the anterior region. It shows a faint constriction about the height of the genital orifices, so that we can distinguish, though not sharply, a neck and a trunk, as in the case of most Ichthyobdellids. The head is wider than the neck and forms a distinct anterior sucker. The skin is irregularly wrinkled all over, and the posterior sucker is very small. These characters led me at first to believe that this was possibly a fresh-water representative of the genus *Pontobdella*. A careful study of the internal anatomy, however, showed that it belonged to the family Glossiphonidae.

All four of the specimens are more or less curved, but not at all contracted, as is inevitably the case with other Glossiphonids placed in alcohol without narcotizing. The measurements are as follows:—

Specimen.	*Length.*	*Wide.*
No. 1	17 mm.	1·6 mm.
No. 2	15·5 mm.	1·5 mm.
No. 3	14 mm.	1·5 mm.
No. 4	13·5 mm.	1·2 mm.

The greatest thickness of specimen No. 1 is about 1·2 mm., the width of the head region 0·7 mm., the diameter of the posterior sucker 0·5 mm. The worm is, thus, more than ten times as long as it is wide, a shape never met with elsewhere in the Glossiphonidae. In this respect it comes nearer to the genus *Piscicola* among the Ichthyobdellidae, which may become twenty times as long as wide when fully extended. In the neck region, which occupies about one-fourth of the whole length, the body is nearly circular in cross section. The trunk, on the other hand, is a little flattened, but still very thick, as the ratio of the breadth to thickness is nowhere greater than 4 : 3. In contrast to *Pontobdella* and *Piscicola* the lateral margins are not wholly obliterated, but are distinctly visible as an obtuse longitudinal ridge along the greater part of the body.

External Characters. The skin is on the whole smooth; neither large tubercles nor small papillae are to be found anywhere. But there are irregular transverse wrinklings all over the surface, which disturb the counting of annuli in some places. Generally there are three to five of rather distinct wrinklings on an annulus besides a number of much fainter ones. This, together with the slender shape of the body, gives the worm an appearance altogether different from an ordinary Glossiphonid.

The colour in alcohol is a uniform ash-grey; Dr. Annandale told me that they were of a pale reddish tint when alive. There is no trace of pattern or stripes of other colour.

So far as I could count with certainty, there are 68 annuli in front of the hinder sucker. As there are no external characters to depend upon, it was found necessary to study the internal anatomy in determining the boundaries of somites. A careful investigation of the nervous system of one specimen, which can not be described here in detail, gave the following results:—

Somite.	*No. of annuli.*
I, II, III	1
IV, V	2
VI—XXIV	3
XXV	2
XXVI, XXVII	1

The first five and last two annuli are incomplete ventrally, being comprised in the formation of the anterior and posterior sucker respectively.

The head consists of seven annuli (somites I—V). It is decidedly broader than the neck and looks, when viewed from above, somewhat like that of *Hemiclepsis marginata*. The oral sucker occupies the ventral side of the first four somites, while the two annuli composing somite V are fused ventrally to form its posterior boundary. The mouth-opening is situated in the middle of the slightly concave sucker.

The eyes are wanting completely. No trace of eye-like organs could be detected even in sections.

In three of the specimens (nos. 1, 2 and 4) a part of the proboscis, ranging from 1·5 mm. to 2·8 mm. in length, was seen protruding from the mouth-opening, so that the tinty hooks so characteristic of the genus could be observed externally. They are three in number, and are arranged radially round the anterior end of the proboscis a short distance from the tip (pl. vii, fig. 9). One is median and dorsal, the other two ventro-lateral. They are of a conical shape, sharply pointed, and are directed obliquely backwards; measured on the outer side they are about 0·25 mm. long. As the proboscis on which they sit is only 0·2 mm. thick, the hooks appear quite conspicuous under the microscope. As to the function of these organs I am at present unable to say anything, though it seems highly probable that they serve as an apparatus for attachment.

The genital orifices are situated one somite further back than in most of the Glossiphonids. The male aperture lies near the posterior margin of the 28th annulus, *i.e.* just in front of the furrow separating somites XII and XIII; the female one ring further back, i.e. in the furrow between the first and second annuli of somite XIII. They are both inconspicuous, as their position is not indicated externally by any prominent structure, such as elevations, glandular patches, etc. The clitellum was not discernible in any of the specimens.

I was not able to detect the nephridial pores externally, but in sections they were found to open in the furrow between the first and second annuli of certain somites.

The posterior sucker is quite small and flat. It is circular as usual, with the diameter less than one-third the breadth of the slender trunk. It is directed obliquely backwards and downwards, and is attached chiefly to the ventral side of the last annulus and partly also of the last but one. Evidently the sucker is not of such vital importance in the life of our animal as in the case of permanently parasitic forms. The anal opening is situated on the dorsal side of the sucker immediately behind the last ring.

Internal Anatomy. What is most striking about the alimentary tract of this leech is the extraordinary length of the proboscis. In the specimen no. 2, which was studied in sections, it was about 7·5 mm. long, i.e. nearly half as long as the body itself. When we consider that in the Glossiphonidae the proboscis measures, as a rule, less than one-sixth of the body-length, this must surely be regarded as an exception. Moreover, it is of a perfectly cylindrical shape through the greater part of the length, even the distal extremity showing no marked diminution in thickness. As regards the internal structure, it exhibits no point of difference compared with that of other Glossiphonids. In it are seen the usual circular and longitudinal muscle fibres traversed by the ducts of unicellular glands which lie dispersed in the anterior region of the body. At the root of proboscis they form a thick bundle on each side, reducing the lumen to a narrow longitudinal slit.

The stomach lies chiefly in somites XVI—XX, and is produced laterally into six pairs of simple diverticula, the last of which extends backwards as far as somite XXIII. The intestine has likewise four pairs of lateral pouches, two of which are directed anteriorly and two posteriorly. The six gastric coeca belong probably to somites XV—XX, and the four intestinal to XXI—XXIV. As in the case of all other Rhynchobdellids the latter are completely enclosed in the sac-like dilatation of the dorsal blood-vessel. The rectum is slightly curved in the shape of an S, and passes to the dorsally situated anus.

The specimen which was studied in sections contained in the stomach only a small quantity of diatom-shells, fragments of vegetable tissue, etc., but not a trace of blood. If we regard these contents as normal, the species should be looked upon as vegetarian in diet—no doubt, a very rare case among the Hirudinea. We know of certain species of Gnathobdellids which occasionally subsist on the organic contents of mud, but this does not seem likely for a Rhynchobdellid, whose slender tube-like proboscis is apparently better adapted for sucking than for swallowing solid particles. The question can only be settled by the direct observation of living specimens.

The genital organs are constructed on Glossiphonid type, but exhibit certain peculiarities in detail. The male apparatus consists of five pairs of testes which lie in somites XVI-XX; the first pair is a little smaller and the last considerably larger than the rest. The testes on each side are connected by short vasa efferentia with a dorsally situated vas deferens which runs forwards and, after forming several coils in somites XIV-XVII, opens in common with its fellow at the posterior margin of somite XII. Each testis lies behind and partly beneath the gastric pouch of that somite. The female organ resembles that of an ordinary *Glossiphonia* in almost every respect. The ovaries are rather long and extend backwards into somite XVII; each narrows to form an oviduct in somite XV and passes forward in an undulating course to the female opening in the anterior part of somite XIII. No special organs for copulation are developed.

The vascular system shows exactly the same structure as in other Glossiphonids. The dorsal vessel has the usual fifteen thick-walled chambers, each provided with a valve-like cellular mass just in front of the constriction separating it from the next one. As already stated, it is dilated posteriorly into a spaceous sac to enclose the whole intestine with its coeca. The number and course of the lateral branches, by which the dorsal vessel communicates with the ventral, are the same as in *Glossiphonia*; namely, four pairs in the anterior and seven pairs in the anal region. There is also an anterior median branch which enters the proboscis at its posterior end and, after passing through its entire length, bifurcates near the tip and then joins again to form the ventral median branch opening into the ventral vessel. In sections both the dorsal and ventral vessels appear very conspicuous on account of their unusually large size, the diameter attaining in some places nearly one-fifth of the breadth of the body.

As in other Rhynchobdellids, the coelome appears as a system of complicated sinuses. There are a dorsal, a ventral, and two lateral sinuses which communicate with each other by segmentally arranged transverse canals. The lateral sinuses are well developed throughout the whole length, but they have no muscular walls, such as are always present in Ichthyobdellids; nor could any pulsating vesicles be found, which are characteristic of a number of genera in this family. Judging from their size the lateral sinuses seem to play an important part in the respiratory function, making the development of other apparatus superfluous.

There are only eight pairs of nephridia belonging to somites XVI-XXIII. This is by far the least number of nephridia found among the Hirudinea, the Gnathobdellids having 16-17, the Glossiphonids usually 13-16, and some Ichthyobdellids 11 pairs. Each organ is quite independent of its neighbours, as is the rule in the Glossiphonidae; its shape and position, too, are exactly the same as in other members of the family. I have paid special attention to the study of these organs in sections, but nowhere could I find a communication between two neighbouring organs which would indicate the formation of plectonephridia resembling those of certain Ichthyobdellids. The nephridial canal opens, without forming a special bladder, into a small invagination of the integument near the posterior margin of the first annulus. At the inner extremity of each nephridium is a capsule with ciliated funnel projecting into the ventral sinus. Their position is indicated by minute rings in pl. vii, fig. 12; as a rule, they are placed at each side of the nervous ganglion of the somite to which they belong. In every case the capsule lies in direct contact with the innermost perforated cell of the nephridium, so that it seems hardly credible that these two structures are independent in function, as maintained by many authors.

The nervous system differs from that of other Glossiphonids in so far as the anterior and posterior ganglionic masses contain each a ganglion more than usual. To compensate this, there are between these masses only nineteen separate ganglia instead of twenty-one. As shown by a careful analysis, the cephalic ganglionic mass is composed of seven, and the anal of eight ganglia. Each ganglion contains, as usual, six packets of nerve-cells, and the boundary between two ganglia is indicated by a narrow space perforating the mass vertically. In the neck region, where the body is very narrow, the nerve-mass appears as enormous, occupying almost the whole space within the body-wall. In short, the nervous system is well developed and exhibits even a higher degree of specialization than in the forms from shallow water.

On the connective tissue and muscular system I have nothing particular to mention, as they differ from those of other Glossiphonids only in detail.

Locality. Lake Biwa, Sta. 8; depth about 260 Japanese feet; bottom, mud with fragments of shell. Oct. 1-3, 1915. Four specimens.

Systematic Position. As is evident from the above account of the internal organization, this leech is more closely allied to the Glossiphonids than to any other, so that it has to be included unquestionably in this family. The resemblance to Ichthyobdellidae, which is so striking at the first sight, is confined to external characters alone, such as the general shape of the body, the appearance of the integument, etc. Of the internal organs, it is chiefly the lacunar system which characterizes this genus as a Glossiphonid; namely, it has no lateral sinuses with muscular walls, the so-called lateral blood vessels, which are never wanting in the Ichthyobdellidae. The structure of the generative organs, too, points to an alliance of this worm with the Glossiphonids, there being no such complicated parts, as are usually met with in Ichthyobdellids. The configuration of the alimentary canal is also of the Glossiphonid type. In short, in every system of organs we have evidences of its being a modified Glossiphonid. Within the family, however, it occupies a rather isolated position on account of its remarkably different shape of the body, the presence of hooks on the proboscis, the small number of nephridia, and many other characters which separate it widely from all other genera hitherto described.

As another example of a Glossiphonid resembling an Ichthyobdellid in external appearance may be mentioned the American genus *Actinobdella*, Moore (1908, 1906), with the species *inequiannulata* and *annectens*. They are very small leeches measuring only 9-12 mm. in length, and look so unlike ordinary Glossiphonids that the first named species was published as belonging to the family Ichthyobdellidae. The body is elongated but more depressed; in contrast to the present genus, there are two large eyes, and the somites are six-ringed in the greater part of the body. Their mode of life is not known, but very probably they are blood-suckers. One example of *A. inequiannulata* was pumped from the bottom of Lake Pepin, Minnesota. I refer to this genus simply to show that *Ancyrobdella* is not the only Glossiphonid which is likely to be mistaken for an Ichthyobdellid if superficially examined.

14. **Ozobranchus jantseanus**, Oka (1912).

Localities. (1) Near Moo-Too. Dec. 1, 1915. Five specimens. (2) Tong-Dong-Ding, Tai-Hu, near Soo-chow. Dec. 4, 1915. Nine specimens. "On *Damonia reevesii.*"

These specimens differ somewhat strikingly from the type, as they have numerous dark brown conical papillae on the dorsal surface which are not found in the latter. I have nevertheless thought it best to place them in the same species because these papillae are not equally developed in all the specimens, and the individuals with the least developed papillae differ only very little from the type. Besides, they all come from the same district. The papillae are of several sizes, and are arranged, though not quite regularly, in transverse rows, large and small intermingled on the larger annuli and small ones only on the smaller. Except for these papillae I notice no important difference between the type and the specimens in the collection. All the examples are strongly contracted, and measure only 4-5 mm. in length.

LIST OF LEECHES RECORDED FROM LAKE BIWA.

I append here a list of leeches hitherto recorded from Lake Biwa, as there are a number of species—some very common—not represented in Dr. Annandale's collection.

HIRUDINIDAE.

Hirudo nipponia. *Whitmania edentula.*
Whitmania laevis.

HERPOBDELLIDAE.

Herpobdella octoculata var. *atomaria.* *Scaptobdella blanchardi.*
H. testacea. *Mimobdella japonica.*

GLOSSIPHONIDAE.

Helobdella stagnalis. *Placobdella rugosa.*
Glossiphonia complanata. *Hemiclepsis marginata.*
Gl. lata. *H. casmiana.*
Gl. smaragdina. *Ancyrobdella biwae.*

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EXPLANATION OF PLATE VII.

IN ALL FIGURES ROMAN NUMERALS REFER TO THE SOMITES.

FIG. 1.—*Myxobdella annandalei*, n. g., n. sp. Diagram showing the annulation of the anterior region.

FIG. 2. Ditto. Diagram showing the annulation of the posterior region.

FIG. 3. Ditto. Anterior extremity. Ventral view. × 5.

FIG. 4. Ditto. Three somites from the middle region. Dorsal view. × 5.

FIG. 5. Ditto. Entire animal. Ventral view. Nat. size.

FIG. 6.—*Hemiclepsis siamensis*, n. sp. A typical somite from the middle region (somite XVIII). × 15.

FIG. 7. Ditto. Posterior extremity. Dorsal view. × 15.

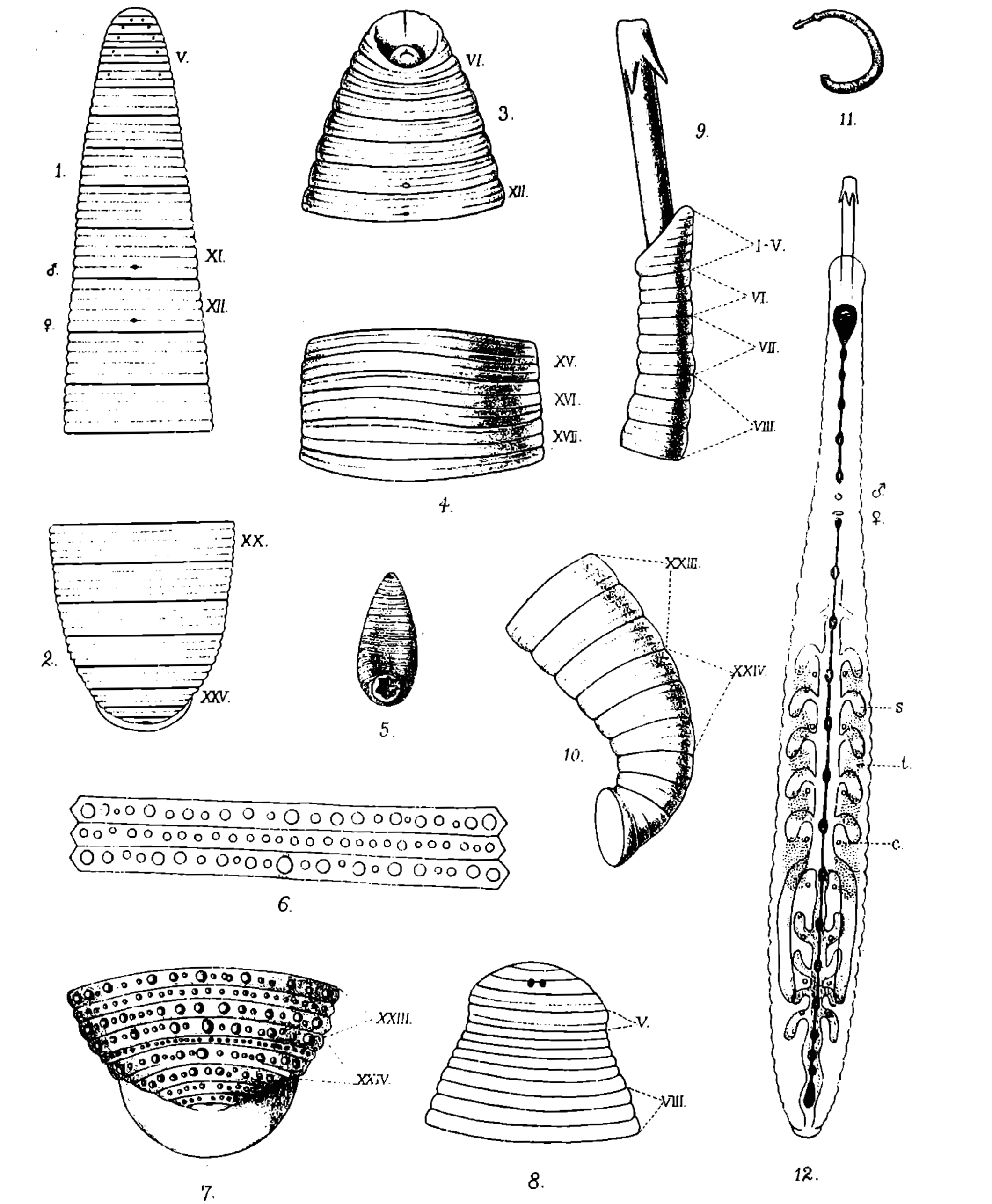
FIG. 8. Ditto. Anterior extremity. Dorsal view. × 15.

FIG. 9.—*Ancyrobdella biwae*, n. g., n. sp. Anterior extremity with proboscis. Side view. × 25.

FIG. 10. Ditto. Posterior extremity. Side view. × 25.

FIG. 11. Ditto. Entire animal (specimen no. 2). × 2.

FIG. 12. Ditto. Diagram showing some of internal organs, *s* one of gastric coeca, *t* testis (3rd pair), *c* nephridial capsule (4th pair).



Oka, del.

A. Chowdhary, lith.

HIRUDINEA FROM THE FAR EAST.

Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

MOLLUSCA NUDIBRANCHIATA (ASCOGLOSSA).

By Sir Charles Eliot, *M.A., D.C.L., LL.D., K.C.M.G., C.B.* (*Principal of the University of Hong Kong*).

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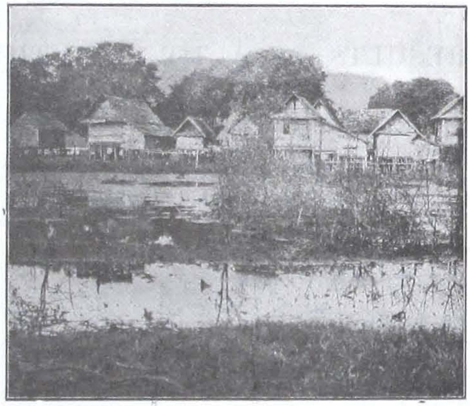


Pool in which *Stiliger tentaculatus* was found.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

MOLLUSCA NUDIBRANCHIATA (ASCOGLOSSA).

By SIR CHARLES ELIOT, *M.A., D.C.L., LL.D., K.C.M.G., C.B. (Principal of the University of Hong Kong).*

Dr. Annandale has kindly allowed me to examine numerous specimens of a small mollusca found by him in brackish water in the Siamese States on the east coast of the Malay Peninsula. They are referable to the genus *Stiliger* belonging to the group Ascoglossa. I agree with Pelseneer and others in regarding this group as a subdivision of the Nudibranchiata, although Bergh held the contrary opinion.

For the genus *Stiliger* see especially Bergh, Malac. Unters. in Semper's *Reisen, Heft.* iii, 1872, pp. 137—144 and *id. Beitr. zur Kennt. der Aeolid.* v, pp. 12—17. It belongs to the family Hermaeidae, all the genera of which are remarkable for their resemblance to Aeolids. It differs from the other members of the family in having large solid rhinophores which are not grooved or ear-shaped. The cerata are thick and inflated. The genus *Ercolania*, Trinchese, seems to be practically the same as *Stiliger*, from which it differs only in having a slight groove on the rhinophores.

Another member of the Ascoglossa, namely *Alderia modesta*, is known to frequent brackish marshes in the British Isles.

Dr. Annandale observes that though a careful search was made for hydroids or other coelenterates on which the molluscs might be feeding in the pools in which they were abundant, none were found. It is probable that the Ascoglossa live on the juices of algae which they pierce with their curiously shaped teeth. The fact that the radula is not used for mastication may account for the remarkable feature, characteristic of the family, that the front teeth are not broken off and thrown away when they become useless, as happens in most molluscs.

Stiliger tentaculatus, sp. nov.

The following are the notes on the living animal made by Dr. Annandale :—

"The shape of the animal was slender; its total length 13 mm. when fully expanded. (The specimens were remarkably uniform in size). The foot was narrow, much produced and sharply pointed behind, the greatest breadth of the sole being 3·5 mm. The head was slightly convex in front. The rhinophores were slender, nearly straight, pointed, each about 4 mm. long. The oral tentacles, which were situated slightly behind the rhinophores, were double; the anterior processes were considerably shorter than the rhinophores, but a little longer than the posterior ones, over which they were usually held retroverted in a semicircle. The posterior processes, which curved backwards very slightly and were rather stouter than the anterior ones, projected almost at a right angle from the sides of the head; the width across the head, from the tip of one process to that of its counterpart on the other side, was 5 mm. The cerata were broadly lanceolate in outline, circular in cross-section; they were not at all inflated at the base but tapered quite gradually from the broadest point, which was situated near the base, to the tip; the total length was not or hardly more than twice the greatest transverse diameter. These structures were very numerous, but were thrown off with extreme readiness. They were arranged on each side of the notum roughly in two alternating rows, those of the outer row being relatively a little more slender than those of the inner row.

"The general colour of the animal was translucent olive-green, considerably darker in some individuals than in others. The head and the posterior part of the foot were almost colourless, the naked part of the back more or less conspicuously marbled—in some individuals it was almost uniform. The cerata were dull transparent green with scattered whitish granular specks that tended to congregate at the tips; in the centre of each, internally, a more or less contorted dark greenish longitudinal mass was conspicuous. The rhinophores were marked, also internally, with groups of whitish granules at the base and at the tips. The eyes were black.

"No nettle-cells were observed, even with the aid of a high power of the microscope, in the cerata of living or freshly killed specimens.

"*Locality*.—Pools of brackish water at Singgora, Siamese States, east coast of Malay Peninsula. January 31st, 1916. Specific gravity of water (reduced to a standard temperature of 15° C.) = 1·0085.

"The animals were crawling in large numbers on a slimy dark green alga that coated the mud at the bottom of small pools of brackish water. The water was in most places less than a foot deep. A very careful search was made for hydroids or other coelenterates on which they might be feeding, but none were found. The pools had been formed by an overflow from the "Talé Sap" (Great Lake) or Inland Sea of Singgora in the rainy season, which was just over. The water must have been of very low salinity to begin with, but the salt was being rapidly concentrated owing to evaporation.

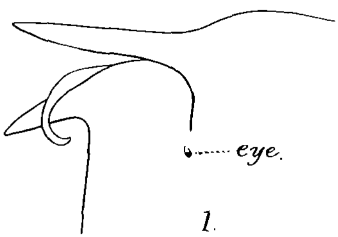
"A single specimen, not observed alive, was found in the collection, on a hydroid (*Bimeria fluminalis*) from the Talé Sap near Singgora. Specific gravity of water (reduced as before) 1·0040. 30. i. 16."

The account given by Dr. Annandale of the relative positions occupied by the rhinophores and tentacles is remarkable, but I understand from a sketch (fig. 1) which he has sent to me and from some further explanations in a private letter that in the living animal the fore part of the head bearing the rhinophores projects above and beyond the mouth—at the upper corners of the mouth are two distinct oral tentacles and below it the anterior margin of the foot is produced into two thin and moderately long processes, which are often held curled over the oral tentacles. If plates representing European forms such as *Stiliger bellulus*,[1] *Placida* and *Hermaea* are

[1] Called *Embletonia mariae* in Meyer and Möbius, *Fauna d. Kieler Bucht.*

examined, it will be seen that they show the rhinophores in a similar position, although the arrangement does not look unusual because there are practically no oral tentacles in these animals.

Dr. Annandale observes that the various tentacles and processes are greatly distorted in the preserved specimens. It is true that none of them resemble his sketch but still the following details seem clear. The rhinophores are moderately long and moderately stout, though thin compared with the cerata. They seem to be round and smooth, as usual in the genus: they are certainly not auriculate and I could find no clear traces of a groove or channel. In many specimens the oral tentacles have shrivelled up but in some are still visible as distinct pointed processes. In some specimens the anterior margin of the foot appears to be grooved and both the upper and lower edges of this groove to be produced into tentacular processes. Though the precise structure and relation of these parts cannot be determined with certainty, it is clear that the tentacular appendages are more in number and more pointed than in other species of *Stiliger*, e.g. *bellulus*.



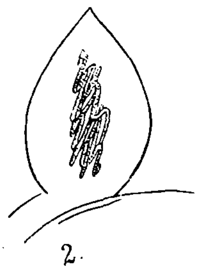


FIG. 1.—Left side of the head. FIG. 2.—One of the cerata.
(From drawings made by Dr. Annandale from the living animal.)

The cerata still retain the general shape and colour described by Dr. Annandale. They are very easily detached and many specimens are quite bare, but have no scars on the back sufficiently clear to mark the position and number of the detached processes. A complete specimen looks superficially as if it were entirely covered with cerata pointing in all directions, but Dr. Annandale is no doubt right in saying that they are arranged on either side in two alternative rows, that is four rows altogether, there seem also to be smaller cerata placed irregularly outside the rows. The number of cerata in a given longitudinal row is not easy to determine as most of the specimens are bent or contracted but probably varies from 12 to 16. The opaque white spots on the cerata are very noticeable and have the appearance of being raised. The hepatic diverticulum within is twisted and covered with knobs but does not appear to be strictly speaking branched. Occasionally three or four very large cerata occur on one animal. It is not plain if this inflation is natural or due to the preserving fluid.

Though a complete specimen often looks like an almost circular bunch of cerata, the body is really slender and tapers to a point behind. The pericardium is not very prominent. The vent appears to be behind it and the genital orifices to the right of it. The eyes are distinct and set behind the rhinophores and a little to the outside of them.

The internal anatomy seems to agree with what is recorded of other species of the genus *Stiliger*. The greater part of the body cavity is filled with the ramifications of the hermaphrodite gland. There are no jaws and the radula is of the ascoglossan type. The teeth are of the usual spoon-like shape and are not denticulate. There are 7 in the ascending portion of the radula, 11 in the descending and about 7, much broken, in the heap at the bottom. The radula is not spiral and not much bent. The pharynx runs into a pouch (presumably to be regarded as a stomach), which lies across the body rather than lengthwise but gives rise to two longitudinal tubes which run along the sides of the body and communicate with the bases of the cerata by smaller tubes.

This species differs from the other known Stiligers, and to the best of my belief from all other members of the family Hermaeidae, in having distinct pointed oral tentacles and tentacular prolongations of the foot. But it does not seem to me necessary to create a new genus for it on that account.

MEMOIRS

OF THE

ASIATIC SOCIETY OF BENGAL

VOL. VI, pp. 183—216.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

EDITED BY N. ANNANDALE, D.Sc., F.A.S.B.

PART IV.

CALCUTTA:
PRINTED AT THE BAPTIST MISSION PRESS, AND PUBLISHED BY
THE ASIATIC SOCIETY, 1, PARK STREET.
1918.

Price Rs. 2; or 3*s.*

30-8-18

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PART IV.

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Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

BRACKISH-WATER POLYCLADS.

By Tokōi Kaburaki, *Rigakushi, Science College, Imperial University, Tokyo.*

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ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

BRACKISH-WATER POLYCLADS.

By TOKIÖ KABURAKI, *Rigakushi, Science College, Imperial University, Tokyo.*

With one plate and two text-figures.

The brackish-water Polyclads serving as basis for the present paper were collected by Dr. N. Annandale in January, 1916, in the Talé Sap or Inland Sea of Singgora on the west side of the Gulf of Siam. The collection, though small and consisting of only two species, is highly interesting, representing, as it does, forms closely allied to *Shelfordia borneensis*, Stummer-Traunfels [1], the only known freshwater Polyclad.

Before proceeding further, I take this opportunity to express my sincere gratitude to Dr. N. Annandale for the privilege of working at the planarians. I further desire to express my best thanks to Professor I. Ijima for many valuable help given me during the work.

Shelfordia annandalei, n. sp.

Pl. VIII, figs. 1—5.—Text-fig. 1.

This new species is based on twenty-eight specimens, all which were collected from the under side of stones and potsherds on the muddy shore of Koh Yaw Island, Talé Sap near Singgora.

Form and size.—According to Dr. Annandale's notes, the anterior part of body in the living state was broadly rounded but not expanded in front, and the posterior end narrower. The body in the preserved condition is elongate-oval, of a firm consistence and without any sign of tentacles, measuring 7·5—12 mm. long by 3—5·5 mm. across in the broadest part. The worms in the living state must have shown about the same ratio of dimensions.

Coloration.—According to the collector's notes taken while the worms were living, the dorsal surface of the translucent body was of an uniform olive-greenish colour without any marking. Some of the smaller specimens were somewhat reddish. The ventral surface was much lighter than the dorsal.

Eye-spots (text-fig. 1).—Tentacular eye-spots of a somewhat large size occur in two oblong clusters, each consisting of 21–23 eye-spots. In the preserved condition the clusters are separated from each other by a median space, about half as wide as their distance from the frontal margin and about one-third as wide as the distance of either

[1] Stummer-Traunfels, R. Ritter, von, 1902. "Eine Süsswasserpolyclade aus Borneo." *Zool. Anz.*, Bd. XXVI, pp. 159–161.

group from the lateral body-margin of the same side. Scattered in the interspace between them are a sparse number of cerebral eye-spots. Further, numerous marginal eye-spots are found completely around the body, more than one deep in the head region but in a single layer in the more posterior parts.

Body-wall (pl. VIII, fig. 3).—The epidermis (ep) consists of ciliated columnar cells which are much higher on the dorsal than on the ventral side, and which are full of minute rhabdites (rh), those on the former side being much more abundant than those on the latter. In the median parts of the ventral surface there exist sometimes no rhabdites at all. Besides, numerous eosinophil glands, deeply imbedded in the parenchyma, open externally in the narrow submarginal zone of the ventral surface.

The basement membrane (bm) is very thick. The dermal musculature, which is

1.

TEXT-FIG. 1.—Eye-spots, tentacular, cerebral and marginal, of *Shelfordia annandalei*. × 30.

better developed on the ventral than on the dorsal side, consists of (1) the outermost circular layer (cm^1) of very delicate and somewhat indistinct nature, (2) the outer longitudinal layer (lm^1), (3) the middle circular layer (cm^2), of great thickness, (4) the inner longitudinal layer (lm^2), and (5) the innermost circular layer (cm^3). Dorsoventral fibres (dvm) occur in all parts.

Digestive System (Pl. VIII, fig. 1).—The mouth (m), situated at the commencement of the middle third of body, opens nearly into the middle of pharynx, which is nearly one-third as long as the body and is provided with about six folds of a moderate size on each side. The main gut (mg) is narrow but of a considerable length, and gives rise to numerous pairs of lateral intestinal branches, the subdivisions of which do not undergo anastomosis. The gut-epithelium is exceedingly poor of Minot's glands, but contains a number of such cells as contain at base numerous homogeneous spherules stainable with eosin.

Nervous System (Pl. VIII, fig. 4).—In this species the nervous system conforms closely to the type found in Polyclads generally. The brain (br), situated slightly in front of the pharynx, is enclosed in a tough capsule, and is of a kidney-like shape consisting of right and left halves divided by a shallow depression. Anteriorly each half is provided with a heap of ganglionic cells, usually known as Lang's "Körnerhaufe" (kh), from which numerous sensory nerves arise. On the ventral side the brain gives rise to six pairs (an, ln^1, ln^2, ln^3, ln^4, pn) of main nerve trunks, of which the last two branch repeatedly and anastomose, bringing about a network extending over nearly the entire ventral side of the body. The remaining nerve trunks also send out some anastomosing branches and finally join the marginal nerve-plexus.

Male Genital Organs (Pl. VIII, figs. 1, 2, 5).—The testes are situated ventrally in the body. Ductules proceeding directly from them can not be brought under observation. The seminal canals (sc), running backwards along the sides of the hind parts of the main gut, somewhat widen in part and thus serve as accessory seminal vesicles. Posteriorly they gradually narrow and unite into an unpaired median duct, the ejaculatory duct (ed), at a point far in front of the male aperture (♂). A true seminal vesicle does not exist. The ejaculatory duct proceeds obliquely backward and upward for some little distance and bends sharply round, finally to open at the tip of penis. At the base of penis, it receives the duct of the prostate from the dorsal side.

The prostatic duct gradually widens anteriorly and passes over into the prostate proper (pr), which represents an elongate tube running forward in a wavy manner and ending blindly considerably in front of the junction point of seminal canals, much as in *Echinoplana celerrima* Haswell[1]. The prostate is internally lined with a non-ciliated epithelium and externally invested with a wall of parenchyma including numerous muscular fibres. In its interior there usually exists a quantity of a finely granular secretion.

The penis (p), which is entirely destitute of a stylet or any other special chitinous structure, is a small and bluntly conical body, projecting from above vertically into the antrum musculinum. This opens directly to the exterior by the male genital aperture, nearly on the anterior border of the last tenth of body.

Female Genital Organs.—As usual the ovaries are dorsally situated, and though there exists an anastomosing system of fine ducts connecting them to the uterine canal, it is difficult to follow this out. The uteri (u), after running closely along the pharyngeal pocket on both sides, unite with each other and form the unpaired uterine duct (uu) in the neighbourhood of the hind end of the main gut; the duct soon joins the median egg-canal (ec). From this junction point the egg-canal extends posteriorly to the point of its origin by union of the two accessory vesicles (av) which, lying one on either side of the median line, extend anteriorly up to the level a short

[1] Haswell, W. A., 1907. "Observations on Australian Polyclads." *Transact. Linn. Soc. London.*, 2. Ser., Vol. IX, pp. 475-478.

distance in front of the middle third of body. The accessory vesicles are each a moderately wide tubular body, the wall of which consists of an actively secretory, columnar epithelium, invested on the outside by fairly well-developed muscular layers. The vesicle contains a quantity of granular secretion apparently derived from the epithelial cells. Anteriorly the egg-canal makes an abrupt downward and backward bend and is continued as a long and posteriorly directed vaginal passage (v), supplying with numerous shell glands and running close along the ventral epidermis. At a point near the blind end of the prostate, the vaginal passage takes an obliquely upward and backward course, running for some distance close to the dorsal epidermis. It then describes an arch, and finally, without forming a vagina bulbosa, opens to the exterior by the female aperture (♀) nearly in the middle of the space between the male aperture and the posterior body-end. In one of the specimens the genital openings were found displaced to a remarkable extent towards the left side of the body.

Remark.—This remarkable and interesting species seems to be somewhat related to *Woodworthia insignis* Laidlaw[1] and *W. atlantica* Bock,[2] but may be distinguished from either chiefly by the absence of tentacles and by the exceedingly prolonged prostate. Decidedly closer seems to be its relation to the freshwater Polyclad, *Shelfordia borneensis*, Stummer-Traunfels, with which it agrees in all essential points of internal and external characters, except in the absence of a true seminal vesicle and of a penial stylet. In my opinion the difference may well be regarded as being of not more than specific value. The generic diagnosis of *Shelfordia*, hitherto known by the single species referred to, should then be slightly modified to run somewhat as follows:—

Stylochidæ with elongate-oval body, without tentacles. Marginal eyes in a crowded row or rows running all round the body. Mouth nearly in the centre of the much-folded pharyngeal chamber. Prostate exceedingly prolonged, opening into ejaculatory duct by a distinct duct. With or without true seminal vesicle. Penis armed or not armed. Vagina of great length, having a bilaterally symmetrical accessory vesicle.

Shelfordia amara, n. sp.

Text-fig. 2.

Only a single representative of this second new species of the genus was captured, in a ditch at Singgora.

As in the preceding species the body in the preserved condition is elongate-oval, moderately firm in texture, and of a dark olive-brownish colour, lighter on the ventral side. It measures 11 mm. long by 3 mm. across in the broadest part. Tentacles are altogether wanting.

Eye-spots (text-fig. 2).—Tentacular and cerebral eye-spots blend together, but the former are somewhat larger than the latter, both being arranged in an irregular

[1] Laidlaw, F. F., 1904. "On the Polyclad Turbellaria collected by Professor Herdman, at Ceylon in 1902." *Report Ceylon Pearl Fisheries of the Gulf of Manaar* by W. A. Herdman. Part II, pp. 128–130.

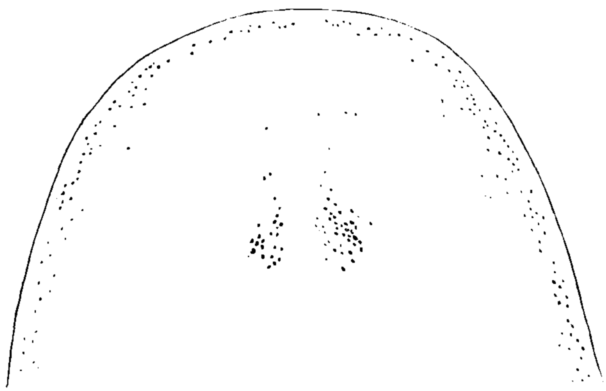
[2] Bock, Sixteen, 1913. "Studien über Polycladen." *Zoologiska Bidrag från Uppsala.* Bd. 2, pp. 142–147.

cluster on either side of the median line, as shown in the accompanying figure. In addition there are present small marginal eye-spots in a large number, arranged partly in a row and partly in crowded rows. They do not extend completely round the body, but cease altogether to exist at about the hind border of the anterior third of body.

Body-wall.—The epidermis contains a large number of rhabdites, less numerously in that of the ventral than of the dorsal side. The basement membrane is very thin, and the muscles of the body-wall is but feebly developed.

Digestive System.—The mouth opens into the centre of the pharynx, which is somewhat less than one-third the length of body and is placed somewhat in front of the middle of the body. The pharyngeal wall is moderately folded. The main gut is long, rather narrow, and possesses numerous pairs of lateral intestinal branches

2.



TEXT-FIG. 2.—Eye-spots, tentacular, cerebral and marginal, of *Shelfordia amara*. × 25.

the subbranches of which nowhere undergo anastomosis. In the intestinal wall there exist as usual a large number of Minot's glands, but the homogeneous spherules observed in the preceding species are not present.

Male Genital Organs.—The following description of the genital end-organs may not be quite accurate, since the specimen was unfortunately in a state unfit for close study.

The testes are ventrally distributed, chiefly in the middle parts of body. The end parts of the seminal canal of both sides expand into the accessory seminal vesicle, the connection of which with the ejaculatory duct could not be exactly determined. The ejaculatory duct, after undergoing much convolution far in front of the penis, pursues a backward course, finally to open at the tip of penis. The penis is a very small, bluntly conical body, projecting into the antrum musculinum. The male aperture is placed near the posterior end of the body. A certain part of the convoluted ejaculatory duct gives rise to an obliquely upwardly and backwardly directed tube, which is provided with a thick wall and probably represents the prostate. The features of the male end-organs seem to differ remarkably from those of any other species of the genus.

Female Genital Organs.—The ovaries are dorsal in position. The end-organs consist of parts closely similar to those of the preceding species. The two uteri unite into a single median uterine duct before joining the median egg-canal. The egg-canal proceeds backward to enter the medial part of the accessory vesicle, which seems to present features similar to those of the same organ of the preceding species. Anteriorly the egg-canal bends abruptly downward and backward, and then takes a posteriorly directed course, in which it is abundantly supplied with shell glands. Unfortunately I have not been able to observe the further course of the egg-canal and the position of the female aperture.

Remarks.—The present species seems to be nearly allied to *Sh. annandalei*, so much so that it may well be referred to the same genus. But it stands distinctly at variance from that species in the arrangement of eye-spots as well as in some points of the genital end-organs, as may be seen from the above description.

In conclusion, a few words with regard to the Polyclads hitherto known from Siam. Since the appearance of Collingwood's memoir [1], our knowledge concerning the Polyclad-fauna of the Malay Peninsula and vicinity has been augmented by Lang [2], Laidlaw [3], Bock [4], and some others. From among the species described by these authors, the following eight forms have been known to occur in Siam :—

(1) *Meixneria furva* Bock.
(2) *Stylochus orientalis* Bock.
(3) *St. orientalis* var. *splendida* Bock.
(4) *St. hyalinus* Bock.
(5) *Notoplana evansi* Laidlaw.
(6) *N. mortenseni* Bock.
(7) *Copidoplana paradoxa* Bock.
(8) *Pseudoceros litoralis* Bock.

The following is a key to all these species and the two described in this paper :—

I. Without sucking disc on ventral surface .. .. .. Suborder Acotylea.
A. Marginal eye-spots present .. .. Section Craspedommata.
a[1]. Tentacles present. Without accessory vesicle to vagina.
a[2]. Vagina very long .. .. Genus *Meixneria.*

[1] Collingwood, V., 1876. "On thirty-one species of Marine Planarians collected partly by the late Dr. Kelaart F.L.S., at Trincomalae, and partly by Dr. Collingwood, F.L.S., in the Eastern Seas." *Transact. Linn. Soc. London*, 2 ser., Zool., Vol. I.

[2] Lang, A., 1884. "Die Polycladen." *Fauna u. Flora des Golfes von Neapel.* XI. Monographie.

[3] Laidlaw, F. F., 1903. "On a Collection of Turbellaria Polycladida from the Straits of Malacca" (Skeat. Exped., 1899—1900). *Proc. Zool. Soc. London.* Vol. I.

[4] Bock, sixteen, 1913. "Studien über Polycladen." *Zool. Bid. f. Uppsala.* Bd. 2.

Body oval, of a brownish black colour. Tentacular eye-spots arranged close together on tentacles; cerebral eye-spots in two groups	1. *M. fulva.*
b^2. Vagina short	Genus *Stylochus.*
a^3. Eye-spots distributed on frontal margin.	
a^4. Body broadly oval, of a greenish brown colour. Tentacular eye-spots confined to the basal parts of tentacles; cerebral eye-spots in two elongate tracts ..	2. *St. orientalis.*
b^4. Body broadly cuneate-oval, with frilled margin, of a yellowish green colour, darker in the median parts. Tentacles large; tentacular eye-spots close together on tentacles; cerebral eye-spots diffuse distributed ..	3. *St. orientalis* var. *splendida.*
a^3. Without eye-spots on frontal margin. Body broadly elliptical, whitish in colour. Tentacle small; tentacular and cerebral clusters of eye-spots distinct but few in number	4. *St. hyalinus.*
b^1. Tentacles absent. With one paired accessory vesicle to vagina	Genus *Shelfordia.*
a^2. Marginal eye-spots completely around body. Body elongate-oval, more broadly rounded anteriorly than posteriorly. Colour generally olive-green, sometimes reddish. Tentacular eye-spots in two somewhat crescentic clusters; cerebral eye-spots irregularly distributed	5. *Sh. annandalei.*
b^2. Marginal eye-spots confined to the anterior third of body. Body elongate-oval, olive brownish coloured. Tentacular and cerebral eye-spots blend together, both arranged in two irregular clusters	6. *Sh. amara.*
B. Marginal eye-spots absent	Section Schematommata.
a^1. Tentacles present or absent. Accessory vesicle of vagina small and rudimentary	Genus *Notoplana.*
a^2. Tentacles present. Body broadly oval, of a yellowish gray or yellowish brown colour. Tentacular eye-spots on tentacles; cerebral eye-spots in two irregular clusters	7. *N. evansi.*
b^2. Tentacles absent. Body oval; colour as in the preceding. Tentacular and cerebral eye-spots in two irregular but distinct groups on each side	8. *N. mortenseni.*
b^1. Tentacles wanting. With accessory vesicle to vagina. Vagina and vaginal duct describing a circle and each opening externally by a distinct aperture	Genus *Copidoplana.*
Body elongate, anteriorly rounded, posteriorly tapering to a point. Colour whitish. Tentacular and cerebral eye-spots blend together	9. *C. paradoxa.*
II. With sucking disc on ventral surface	Suborder Cotylea.
Marginal tentacles present	Genus *Pseudoceros.*
Body oval, of a blackish brown colour, blotched with colourless flecks and bordered all round with a double band, the inner chrome-yellow and the outer black	10. *P. litoralis.*

Localities of the Polyclads found in Siam.

Species.	Gulf of Siam.						Inland Sea.		
	Cap Liant.	Koh Chang	Koh Kam.	Koh Mesan.	Between Koh Mesan and Koh Chuen.	Lem Ngob.	Koh Yaw.	Singgora.	Talé Sap.
Meixneria furva						×			
Stylochus orientalis ..			×		×				
St. orientalis var. *splendida* ..			×						
St. hyalinus			×						
Shelfordia annandalei ..							×		×
Sh. amara								×	
Notoplana evansi ..	×	×		×					
N. mortenseni		×							
Copidoplana paradoxa ..		×							
Pseudoceros litoralis ..		×				×			

EXPLANATION OF PLATE VIII.

FIG. 1.—*Shelfordia annandalei.*		Diagrammatic combination figure of an entire worm; dorsal aspect. 16 ×.
FIG. 2.	Ditto.	Diagrammatic representation of the genital end-organs in longitudinal section. 60 ×.
FIG. 3.	Ditto.	Body-wall in longitudinal section. 300 ×.
FIG. 4.	Ditto.	Diagrammatic representation of the brain, as seen from the dorsal side. 140 ×.
FIG. 5.	Ditto.	Cross section of body passing slightly in front of the dividing point of the ejaculatory duct into the seminal canals. 150 ×.

ABBREVIATIONS USED IN THE EXPLANATION OF PLATE.

an ..	.. anterior nerve trunk.	me ..	.. marginal eye-spots.
av ..	.. accessory vesicle of vagina.	mg ..	.. main gut.
bm ..	.. basement membrane.	n ..	.. nerve.
br ..	.. brain.	ov ..	.. ovary.
ce ..	.. cerebral eye-spots.	p ..	.. penis.
cm^1, cm^2, cm^3	.. circular muscles.	ph ..	.. pharynx.
dvm ..	.. dorso-ventral muscle.	pn ..	.. posterior nerve trunk.
ec ..	.. egg-canal.	pr ..	.. prostate.
ed ..	.. ejaculatory duct.	rh ..	.. rhabdite.
ep ..	.. epidermis.	sc ..	.. seminal canal.
g ..	.. gut.	te ..	.. tentacular eye-spots.
kh ..	.. "körner-haufe."	u ..	.. uterus.
lm^1, lm^2	.. longitudinal muscle.	un ..	.. unpaired uterine duct.
ln^1, ln^2, ln^3, ln^4 ..	.. lateral nerve trunks.	v ..	.. vaginal passage.
m ..	.. mouth.		

♂ .. .. male genital aperture.
♀ .. .. female genital aperture.

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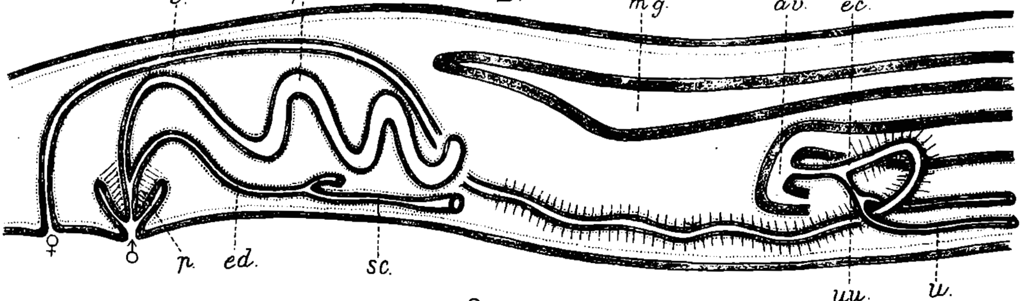

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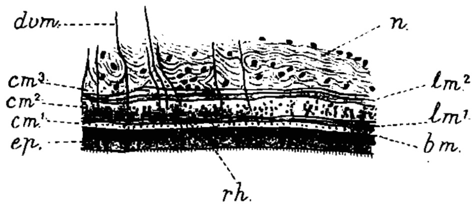

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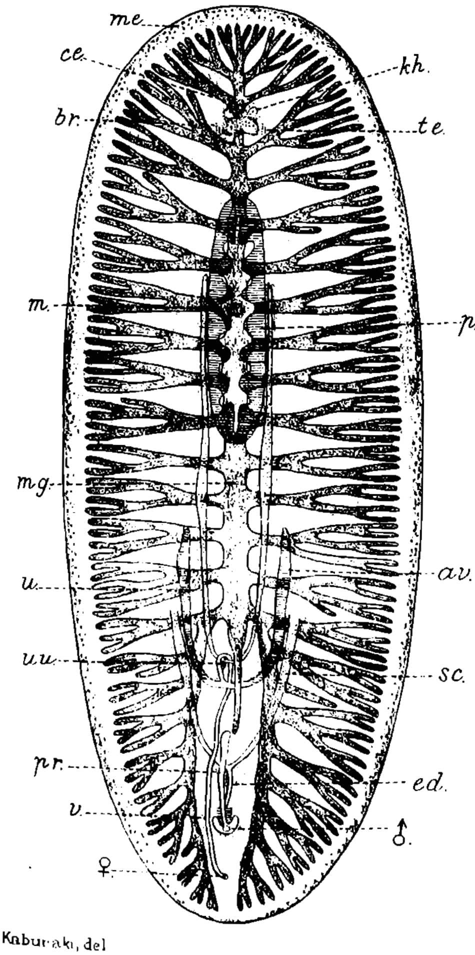

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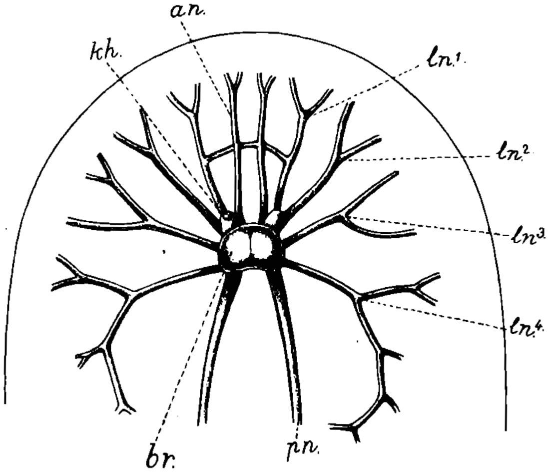

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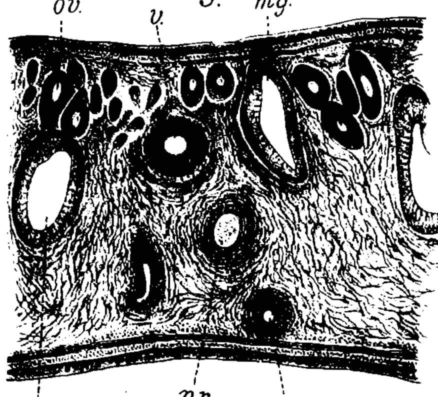

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BRACKISH WATER POLYCLADS.

Mem. Asiat. Soc. Bengal, Vol. VI

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

SPONGES.

By N. Annandale, *D.Sc., F.A.S.B.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

SPONGES.

By N. ANNANDALE, *D.Sc.*, *F.A.S.B.* (*Zoological Survey of India*).

Plate II, figs. 3, 5; Plate IX.

I. TWO MARINE SPONGES FROM A CREEK IN THE MALAY PENINSULA.

The two sponges discussed in this note were found growing on the wooden piers of a landing stage at Port Weld in Perak on the east coast of the Malay Peninsula. This place is situated some miles up a narrow creek that opens into the Straits of Malacca, but, so far as I could learn, the water remains quite or almost salt at all seasons and at all states of the tide. The chief biological interest of the sponges lies not in their precise locality but in the fact that they grew high up on the piers immediately below high-tide level and were, therefore, exposed daily for considerable periods to the air and to the heat of a tropical sun. Moreover, the water which covered them at high tide was full of finely divided silt.

The two species belong to two different genera and families of the Monaxonellida, one to the genus *Renicra* of the family Haploscleridae, the other to the peculiar and somewhat anomalous genus *Amorphinopsis*, which is assigned provisionally to the Axinellidae.

The *Reniera* is a well-known species (*R. implexa*, Ridley & Dendy) of very wide bathymetric range in the warmer seas, while the *Amorphinopsis* seems to be no more than a phase or variety of a species (*A. excavans*, Carter) of which two other forms remarkably different in external structure have already been described from the eastern side of the Bay of Bengal.

The most interesting feature of the bionomics of these two sponges is the divergence of the means whereby they are able to exist in the peculiar circumstances in which they were found at Port Weld. *R. implexa* is remarkable in its genus in that the sponge forms masses of more or less finger-shaped and at least partially hollow processes each of which is provided with a large and gaping osculum. Indeed, this is its most constant specific character, for its spicules, which are of one kind only, vary considerably in size and proportions in different specimens. The sponge is thus unusually cavernous and is able to retain a considerable amount of water in its interior. Were it not for the fact that the species has been found not only in rock-pools and on the walls of a harbour but also in the deep sea, this structural peculiarity might be taken as an adaptation to enable it to resist external desiccation. Possibly it may be correlated with life in muddy water, and even if it has not been evolved in direct correlation with life in very shallow water, it must be useful in the circumstances in which the sponge was found at Port Weld. In my Malay specimens the processes are recumbent or semi-recumbent.

The other sponge, for which I propose the name *Amorphinopsis excavans* var. *robinsonii*, is, more strictly speaking, an encrusting sponge. It has a very massive structure in spite of its thinness, but contains relatively broad water-channels running parallel to the surface a short distance below the external membrane. The two other phases of the species already known differ considerably in their mode of life. The *forma typica* was found growing on, or rather in, rotten coral in the Andamans. It forms a very thin film on the surface of the coral and sends root-like processes down into the burrows of Clionidae, the spicules of which it sometimes incorporates within its own substance. The outgrowths on its external surface are very short and compact. The var. *digitifera*, on the other hand, was found growing on hard rock and had incorporated numerous shells and pebbles, which it had not dissolved or excavated. It formed a mass of short, pointed, somewhat compressed upright branches of rather irregular outline, joined together by means of a relatively thin crust. The longest branches were about 10 cm. long by 4 cm. broad. The new variety is almost exactly intermediate between these two forms, consisting mainly of a crust about 5 mm. deep, but bearing numerous short upright processes not more than 3 mm. long. It has no basal root-like outgrowths. Like all the phases of the species it is able to close its oscula and pores very tightly. The large holes shown in the photograph of a fragment reproduced on Pl. II of this volume are due to the burrows of a mollusc in the wood below the sponge, and do not open into the interior of the sponge, which merely grows round them.

The two sponges on the landing stage at Port Weld have not, therefore, undergone any special structural evolution in correlation with the particular dangers to which they are exposed, *viz.* those of partial disiccation and of muddy water. They possess structural peculiarities that identical or closely related sponges living in totally different circumstances also possess, but these peculiarities are of great use to them in their peculiar environment. Without peculiarities of some kind, indeed, they would hardly have been able to establish themselves in their present habitat. The useful structural features are not the same in the two sponges. In the *Reniera* the principles adopted are those of receiving water in large empty spaces and of giving a free passage to small particles of inorganic matter through patent channels. In the *Amorphinopsis*, on the other hand, the open spaces are more restricted, the whole structure more massive and the orifices capable of complete contraction. The two sponges thus afford a parallel to two other cases of a similar nature that I have discussed recently, namely that of *Nudospongilla asper* and *Cortispongilla barroisi* in the Lake of Tiberias[1] and that of *Tetilla dactyloidea* var. *lingua* and *T. limicola* in muddy lagoons on the coasts of India and Ceylon.[2] In both cases we find sponges living in muddy water and adopting divergent means of protection, in one species by decreased size of the aper-

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[1] *Journ. As. Soc. Bengal* (n.s.), IX, p. 75 (1913).

[2] *Mem. Ind. Mus.* V, p. 54 (1915).

tures and even of the channels, in the other by increased size of the apertures and channels. The freshwater sponges, however, and the two species of *Tetilla* are in each instance closely related forms, not, as in that of the sponges at Port Weld, belonging to different families. In both instances, moreover, the chief danger is that of water containing inorganic particles liable to cause obstruction in the canals of the sponge; the danger of desiccation hardly entered into the question. Moreover, we know of cases, such as that of *Spongilla alba* in the Gangetic delta, in which the adaptations of sponges living in muddy water are physiological rather than structural.

Family HAPLOSCLERIDAE.

Reniera implexa, Schmidt.

1868. *Reniera implexa*, Schmidt, *Spong. Algier*, p. 27.
1887. *Reniera implexa*, Ridley and Dendy, "*Challenger*" *Rep.* XX, *Monaxonida*, p. 15, pl. i, fig. 4.
1892. *Siphonochalina mollis*, Topsent. *Rés. Camp. Sci. Monaco* II, p. 66.
1903. *Reniera implexa*, *id.*, *ibid.* xxv, p. 244.
1905. *Reniera implexa*, Dendy, *Sponges*, *in* Herdman's *Rep. Ceylon Pearl Fish.* III, p. 142.
1914. *Reniera implexa*, Annandale, *Rec. Ind. Mus.* X, p. 151.

This species is variable in the size of its spicules, the structure of its skeleton and the direction of its main growth. A constant specific character is, however, that the sponge consists of a mass of more or less cylindrical tubes with large oscula at their free extremities and of hollow structure. In typical specimens from the Adriatic and in those from the Azores (of which one is figured by Ridley and Dendy) the tubes are vertical, but in all those I have examined from India and Malayan waters they are recumbent or semi-recumbent.

In the collection of the Zoological Survey of India there are examples from three localities, from a rock-pool at Bandra near Bombay, from Madras harbour and from Port Weld. Those from the two Indian localities agree with the specimens from Ceylon described by Dendy as "consisting of a few irregularly branched tubes." In one from Madras harbour, fixed to a mussel-shell, there are only two tubes, which are only 2·5 mm. in diameter. Others from Bombay are rather better developed, but the tubes are not more than 5 mm. in diameter. Specimens from Port Weld originally formed a rather dense network covering a considerable area and confused with the growth of the new variety of *Amorphinopsis excavans* described below. Their tubes are sometimes as much as 7 mm. in diameter but are less regular in shape and uniform in diameter than in some specimens.

The following are average measurements of spicules from the three lots of specimens:—

	Madras.	Bombay.	Perak.
Length of spicule ..	0·096 mm.	0·116 mm.	0·152 mm.
Greatest breadth of spicule ..	0·0038 mm.	0·0054 mm.	0·0063 mm.

In spite of these considerable differences in size and proportions, the spicules agree in general form, being very sharply and gradually pointed and as a rule slightly bent.

The skeletons of the different specimens exhibit the same variation as has been noted in specimens from other localities. In one from Madras, which was preserved with great care so as to avoid all pressure, the skeleton, as in Schmidt's original specimens, forms an irregular network of single spicules. On the external surface single spicules also project outwards from the nodes of this network. In examples from Bombay, on the other hand, longitudinal spicule-fibres 4 or even 6 spicules thick are well developed. In the Perak specimens the condition is intermediate, for the longitudinal fibres, though they can be detected, are not at all well defined and have not more than 3 spicules abreast.

Of all known sponges *Reniera implexa* has one of the greatest, if not the greatest of bathymetric ranges. It has been found in shallow water in the Adriatic and on the coasts of India and Ceylon, at various depths, all considerable, up to 450 fathoms in the Atlantic, and now between tide-marks in the Straits of Malacca. Differences in size of spicules or in skeleton-structure are not correlated with depth of habitat, but it is probable that an upright growth is maintained only in very still water.

Family AXINELLIDAE.

Amorphinopsis excavans, Carter.

1915. *Amorphinopsis excavans*. Annandale, *Rec. Ind. Mus.* XI, pp. 467–470, figs. 4, 5.

I have redescribed this species, with a new variety, in the paper cited. Here I have to describe a second new variety.

var. **robinsonii**, var. nov.

(Plate II, fig. 3; plate IX, fig. 1.)

The sponge formed a layer about 5 mm. thick and of considerable area. It had a greenish-grey colour when alive and is grey in spirit. It is tough and rather elastic, not very hard. The surface is uneven, covered with a network of low ridges which often bear at the nodes short upright conical projections not more than 3 mm. high. These projections have a hirsute appearance under a hand lens. No orifices are apparent in the preserved sponge but the whole structure is pierced by a number of oval gaps of relatively large size. These, however, are not natural to the sponge but covered the burrows of bivalve molluscs burrowing in the wood to which it was attached.

In internal structure the sponge closely resembles the typical *A. excavans* (*op. cit.*, 1915). The upright spicule-fibres are well defined and below the external surface are splayed out as shown in fig. 1 on pl. IX. There is also an irregular skeletal reticulation of spicules of various forms and sizes and a distinct external layer of small spicules arranged horizontally in the ectosome. The conical projections on the surface apparently represent conuli in which the orifices are closed by contraction. Large horizontal channels with a circular or horizontally oval cross-section run through the substance of the sponge, especially in the region immediately below the ectosome. There is a stout horny basal membrane.

The normal spicules are of three types and each type is represented among those both of large and of small size. All are smooth. The three types are (1) straight or feeble curved styli, (2) curved amphioxi with a median swelling and (3) curved or geniculate amphioxi without any swelling of the kind.

(1) The larger spicules of this type occasionally reach a considerable size and may be as much as 0·548 mm. long; but this is exceptional. They are not less than 23 times as long as broad. The head is not at all dilated but abruptly rounded; the diameter of the spicule is uniform for about $\frac{3}{8}$ of its length. The tip is gradually and sharply pointed. The smaller spicules of this type are from 0·15 mm. to 0·3 mm. long and have similar proportions to the larger ones. Occasionally they bear a median swelling. Styli of all kinds are scarce.

(2) The proportion of amphioxous spicules with a median swelling is small. I have not been able to find geniculate spicules of this type. Large amphioxi with the swelling are sometimes as much as 0·44 mm. long, but often not more than 0·2 mm. They are from 24 to 25 times as long as broad, omitting the swelling. The extremities are sharply and gradually pointed.

(3) The majority of the spicules are of this type, slender, amphioxous, curved or geniculate, without median swelling. The proportions of geniculate spicules is small, but such spicules occur among both the large and the small amphioxi. The length is from 26 to 33 times as great as the maximum breadth and the extremities are sharply and gradually pointed.

Abnormal spicules with one extremity angulate are not uncommon among those of larger size.

Type-specimen. No. ZEV. 7137/7, Zool. Survey of India (*Ind. Mus.*).

Locality. Port Weld, Perak, Malay Peninsula: between tide-marks on a landing-stage in a salt-water creek some miles up from the Straits of Malacca.

This sponge is distinguished from the two varieties of *A. excavans* already described by Carter (*op. cit.*; 1887) and myself (*op. cit.*; 1915) mainly in external structure. There are, however, slight differences in the spicules.

II. FRESHWATER SPONGES FROM JAPAN, CHINA AND THE MALAY PENINSULA.

A. JAPANESE SPECIES.

The archipelago of Japan is still to a large extent unexplored so far as the Spongillidae are concerned and only two of its numerous lakes have been investigated. These lakes are Lake Biwa in the interior of the Main Island and Kasumi-ga-Ura on the Pacific coast of the same island. The sponges of Lake Biwa have recently been discussed in considerable detail by Dr. T. Kawamura and myself, and no species which does not occur in the lake has been found elsewhere in Japan. The only form in which this is the case is the *forma typica* of *Ephydatia mulleri*, which has been found at Tokyo, but in neither lake. It will be sufficient here to give a list of the known Japanese species and to publish an adequate diagnosis of a new form incorrectly identified in the former paper.

List of the Japanese species :—

Spongilla (*Euspongilla*) *lacustris*, auct.

Spongilla (*Euspongilla*) *semispongilla* (Annandale).

Spongilla (*Euspongilla*) *inarmata*, sp. nov.

Spongilla (*Stratospongilla*) *clementis*, Annandale.

Spongilla (*Eunapius*) *fragilis*, Leidy.

Ephydatia mülleri (Liebk.).

Ephydatia mülleri var. *japonica* (Hilgendorf).

Heteromeyenia kawamurae, Annandale.

Spongilla inarmata, sp. nov.

(Plate IX, fig. 2.)

1917. *Spongilla aspinosa*. Annandale and **Kawamura** (*nec* Potts). *Journ. Coll. Sci. Tokyo*, XXXIX, p. 8, pl. ii, fig. 1.

I have compared a fragment of the sponge from Lake Biwa noticed by Dr. Kawamura and myself under the name *Spongilla aspinosa* with an authentic specimen of that species from the United States of America and find the differences much greater than we believed to be the case. It becomes necessary, therefore, to describe the Japanese form as a new species.

The sponge forms a thin, very brittle crust and has (dry) a yellowish colour; the external surface is irregular and pitted, and upright bunches of spicules project through the external membrane in the form of spines.

The skeleton forms a close, irregular network in which it is possible to distinguish only ill-defined and relatively broad spicule-fibres.

The gemmules lie at the base of the sponge, probably attached to a basal membrane, of which only traces remain in the specimen examined. They are fairly numerous and vary considerably in size; their outline is often oval. Each gemmule is covered with a rather thick layer of "granular" pneumatic substance and is enclosed in a regular network of macroscleres, which are sometimes slightly smaller than those of the skeleton. There is a single foraminal tubule, which is not conspicuously curved.

The macroscleres are of moderate size, relatively slender, straight or feebly curved, perfectly smooth and sharply pointed at both ends. There are no gemmule-spicules. The flesh-spicules are practically confined to the dermal membrane; they are slender, sharply and gradually pointed at both ends and as a rule somewhat crescentic in form; they bear short scattered spines on the middle region, but are smooth or almost smooth at the extremities.

Measurements of spicules :—

Length of macrosclere	0·288 mm.
Breadth of macrosclere	0·012 ,,
Length of microsclere	·052—·068 mm.

Type-specimen. No. P, 49-1, Zool. Survey of India (*Ind. Mus.*).

Locality. Lake Biwa, Japan (T. Kawamura: 24-7-15).

This sponge differs from *S. aspinosa*, Potts in its stouter skeleton-spicules, spined microscleres and stouter and less regular skeleton. It has no relationship to *S. sinensis*, with which we formerly compared it. As it is devoid of gemmule-spicules its precise systematic position is a little uncertain, but as the gemmules possess a well-developed pneumatic layer, it seems best on the whole to place it in the subgenus *Euspongilla*.

B. Chinese Species.

Freshwater sponges are known from only two of the provinces of China, from Yunnan in the west and Kiangsu in the east. From Yunnan three species have been recorded, *Spongilla* (*Euspongilla*) *lacustris*, auct., *S.* (*Stratospongilla*) *clementis*, Annandale (syn. *S. yunnanensis*, *id.*) and *Nudospongilla coggini* (Annandale). From Kiangsu I am able, thanks largely to the assistance of the Rev. N. Gist Gee of Soochow, to record ten species, of which six are known only from that province. The following is a list of the ten species now known from Kiangsu :—

- *Spongilla* (*Euspongilla*) *micron*, Annandale.
- *Spongilla* (*Euspongilla*) *semispongilla*, (Annandale).
- *Spongilla* (*Eunapius*) *geei*, sp. nov.
- *Spongilla* (*Eunapius*) *conifera*, Annandale.
- *Spongilla* (*Stratospongilla*) *sinensis*, Annandale.
- *Spongilla* (*Stratospongilla*) *stanleyi*, Annandale.
- *Ephydatia meyeni* (Carter).
- *Ephydatia bogorensis*, Weber.
- *Trochospongilla latouchiana*, Annandale.
- *Trochospongilla sol*, sp. nov.

Two (*E. meyeni* and *T. latouchiana*) of the four species found outside the province occur in India; *E. meyeni* has been found also in Sumatra and *T. latouchiana* in Burma. *E. bogorensis* was described from the Malay Archipelago, and *S. semispongilla* from Japan.

Genus **Spongilla**, Lamarck.

Subgenus **Euspongilla**, Vejdovsky.

Spongilla micron, Annandale.

1916. *Spongilla* (*Euspongilla*) *micron*, Annandale, *Journ. N. China Roy. As. Soc.*, XLVII, p. 49.

This species is closely allied to *S. alba*, Carter and *S. semispongilla* (Annandale). From the former it differs in its invariably minute size, in the sub-rotulate form of its gemmule-spicules and in the absence of true flesh-spicules; from *S. semispongilla* it may be distinguished by the entire absence of chlorophyl bodies and by its much more slender macroscleres. The macroscleres are always smooth but often somewhat abnormal in form (see figure). There are no true flesh-spicules but immature gemmule-spicules often occur in considerable numbers in the parenchyma. I regret to say that the original description gives a totally wrong account of the measurements of the spicules owing to the fact that the specimen selected as the type was a mixture of two species. The actual length of the skeleton-spicules is about 0·42 mm. and they are about twenty-one times as long as thick.

Localities. The Tai-Hu (type-locality) and Soochow (*Gee*), Kiangsu Province, China.

Type-specimen. ZEV. 7103/7, Zool. Survey of India (*Ind. Mus.*).

This sponge grows on the leaves of submerged water-plants.

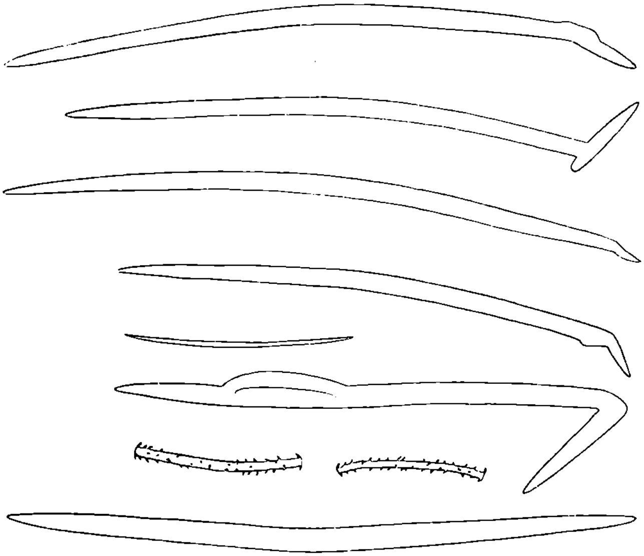

FIG. 1.—Spicules of *Spongilla micron*, × 250.

Spongilla semispongilla (Annandale).

1909. *Ephydatia semispongilla*, Annandale, *Annot. Zool. Jap.*, VII, p. 107, pl. ii, fig. 2.
1916. *Spongilla semispongilla*, Annandale and Kawamura, *op. cit.*, p. 5, pl. i, fig. 4.

Mr. Gee has sent me a fragment of this sponge from Soochow. It was growing with *Ephydatia bogorensis*. The species has otherwise been found only in the Main Island of Japan.

Subgenus **Eunapius**, Gray.

Spongilla geei, sp. nov.

I describe this species from a broken fragment about 40 mm. long. The sponge appears to be massive and of irregular form. It was evidently in a degenerate condition when discovered, and in this state has a greyish colour.

The skeleton is very compact, but contains little horny matter; both vertical and transverse fibres are well-developed and thick, forming together a fairly regular network.

The gemmules are subspherical but a little broader than high, they are small and very numerous, and are not grouped, but scattered singly through the substance of the sponge, each closely embraced in the network of the skeleton. The pneumatic layer is thick and uniform, its cells relatively large. There is a single, long, curved, foraminal tubule, lying in a crater-like depression in the pneumatic coat. The gemmule-spicules are scattered among the inner cells of this coat and also on its external surface; they lie more or less parallel to the surface of the gemmule.

The macroscleres are small, stout, smooth, straight or feebly curved, somewhat bluntly and abruptly pointed at both ends. The axial channel can often be detected in them. There are no flesh-spicules. The gemmule-spicules, which are not at all numerous, are small and slender, irregularly spiny and as a rule pointed at both ends. Their spines are always very short.

Measurements :—

Gemmule	.. .. .	0·476 × 0·425 mm.
Length of macrosclere	.. ..	0·168 — 0·2 ,,
Breadth of macrosclere	.. ..	0·016 — 0·024 ,,
Gemmule-spicules	.. .. ..	0·072 — 0·08 ,,

Locality. Loen Mong, Soochow, Kiangsu Province, China. (*Gee*).

Type-specimen. No. P. 50/1, Zool. Survey of India (*Ind. Mus.*).

This species resembles *Spongilla nitens*, Carter from tropical Africa more closely than any other, but the skeleton-spicules are considerably smaller and are pointed instead of being rounded at the tips and the skeleton is less massive.

Spongilla conifera, Annandale.

(Plate IX, figs. 3-5).

1916. *Spongilla conifera*, Annandale, *op. cit.*, p. 51.

The most remarkable features of this sponge are the small size of all its parts and the peculiar structure of the gemmules; this is clearly shown in the figures on pl. IX. Round the base of the gemmule there is often a circle of minute spinelets formed owing to an imperfect development of the pneumatic cells in this region.

I have discovered a few free-microscleres in specimens since the original description was published. These microscleres are cylindrical, straight, blunt at the extremities and covered with short spines. Minute smooth amphioxi occur occasionally in the parenchyma, but are probably young macroscleres, also spiny amphioxi and amphistrongli which are apparently adventitious. The macroscleres are occasionally amphistrongylous and vary greatly in size, proportions and outline; they are always smooth.

Subgenus **Stratospongilla,** Annandale.

Spongilla sinensis, Annandale.

1910. *Spongilla* (*Stratospongilla*) *sinensis*, Annandale, *Proc. U.S. Nat. Mus.*, 38, p. 183.

Mr. Gee has sent me further specimens from Soochow, the original locality, and from Foo Mong in the same neighbourhood. The gemmule-spicules are often very irregular, never spiny. I have nothing else to add to the original description.

Spongilla stanleyi, Annandale.

1916. *Spongilla (Stratospongilla) stanleyi*, Annandale, *op. cit.*, p. 50.

This sponge, which has been found as yet only in the Tai-Hu on the lower surfaces of stones and on shells (living) of *Vivipara lapillorum*, closely resembles

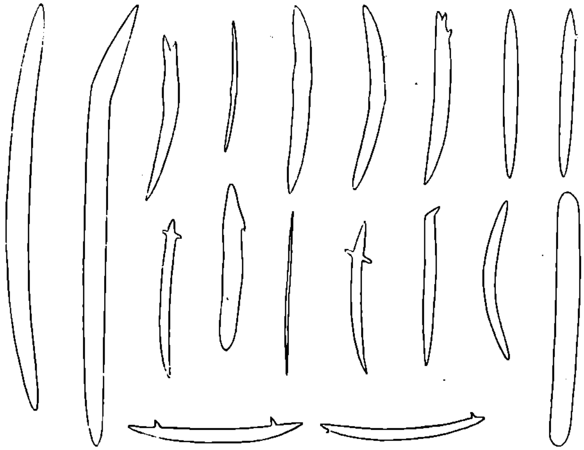

FIG. 2.—Spicules of *Spongilla sinensis*, × 250.

S. sinensis in structure, but differs in the greater irregularity and habitual spininess of the gemmule-spicules. The two species form a distinct group in the subgenus, differing considerably from any other with which I am acquainted.

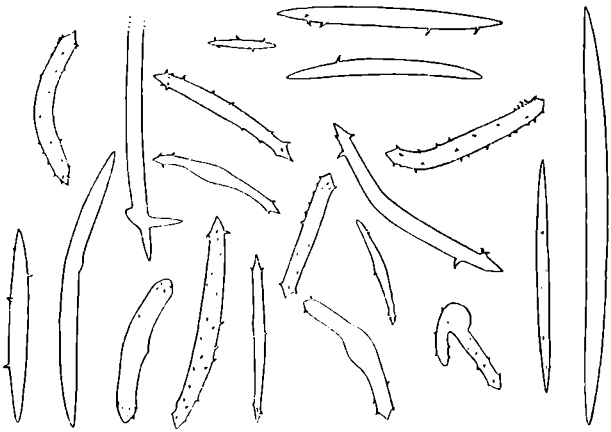

FIG. 3.—Spicules of *Spongilla stanleyi*, × 250.

Genus **Ephydatia**, Lamouroux.

Ephydatia meyeni (Carter).

1911. *Ephydatia meyeni*, Annandale, *Fauna Brit. Ind.*, *Freshw. Sponges*, etc., pp. 108, 109, fig. 21.

Mr. Gee has sent me specimens from Foo Mong, Soochow which undoubtedly belong to this species. The skeleton-spicules are smooth, but often irregular in outline, the gemmule-spicules as a rule rather stout, the length of the shafts hardly exceeding the diameter of one rotule. Some, however, are considerably longer. The shaft is as a rule smooth, but occasionally bears one or two short spines. The skeleton is compact. Bubble-cells are numerous in the parenchyma. The specimens are too fragmentary to permit any statement as to the external form of the sponge.

Embryos and young gemmules occur together in a fragment I have examined. Numerous gemmule-spicules lie free in the parenchyma.

Ephydatia bogorensis, Weber.

1890. *Ephydatia bogorensis*, Weber, *Zool. Ergebn. Res. Nied. Ost.-Ind.*, I, p. 33, pl. iv, fig. 11.

The sponge forms small irregular masses attached to weeds. In spirit it is of a dirty white colour; it is soft and the texture rather loose; the external surface appears to have been smooth and no large apertures are apparent. Slender horizontal spicule-fibres are well-defined, branching freely in the sponge, but the transverse fibres are irregular and ill-defined. I can detect no bubble-cells.

The gemmules are small, spherical, densely covered with upright spicules, but with the pneumatic layer feebly developed. There is a single short foraminal tubule. The skeleton-spicules are short, slender and as a rule sharply pointed at both ends. Their outline is irregular and they sometimes bear short scattered spines. The gemmule-spicules are long and have relatively small rotules, which have minutely denticulated and somewhat introverted margins. The shafts bear a considerable number of sharp, moderately elongate spines. These spicules are scattered in considerable numbers in the parenchyma, as well as surrounding the gemmules.

I have compared specimens collected at Soochow by Mr. Gee with one from Java sent me by Dr. Max Weber. There are slight differences in the form and proportions of the skeleton-spicules, but the structure of the skeleton and of the gemmule is identical.

E. bogorensis has been recorded from Java and Celebes. It is closely related to *E. blembingia*, Evans, from the Malay Peninsula. The gemmule-spicules of both species resemble those of *Dosilia plumosa*, Carter.

Genus **Trochospongilla,** Vejdovsky.

Trochospongilla latouchiana, Annandale.

1911. *Trochospongilla latouchiana*, Annandale, *op. cit.*, pp. 114, 115, figs. 23A, 24.

A specimen collected by Mr. Gee at Loean Mong, Soochow agrees with Indian examples, except that the shafts of the gemmule-spicules are a little longer, nearly equalling the diameter of a single rotule.

Trochospongilla sol, sp. nov.

(Plate IX, fig. 6.)

This sponge is described from a number of dry specimens attached to the lower surface of a stone. They form small oval or circular patches of a pale yellowish colour and consists of groups of gemmules covered by skeleton-spicules. No patch is more than 5 mm. long. It is impossible, therefore, to describe the structure of the sponge.

The gemmules are firmly attached to the stone and lie closely adjacent to one another; each is covered by a dome formed of a dense network of single skeleton-spicules, the different domes coalescing at the margin. Each gemmule is nearly spherical, but the upper surface of most of them has collapsed and become concave. In the middle of this surface there is a single curved forminal tubule, which projects through the dome of skeleton-spicules.

The skeleton-spicules are very small and relatively slender, sharply pointed at both ends and densely covered with short spines. The gemmule-spicules are minute. Their rotules are relatively large and their shafts short. Both rotules are slightly

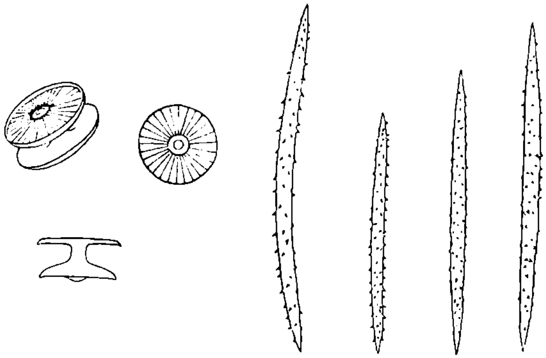

FIG. 4.—Spicules of *Trochospongilla sol*; macroscleres, × 250: birotulates, × 780.

concave and the upper rotule is slightly smaller than the lower one, the shaft projects upwards as a nob in the middle of the upper rotule; the surface of the rotules is ornamented by straight radiating striae.

Measurements:—

Diameter of gemmule	..	..	0·357 mm.
Length of macrosclere	..	..	0·162—0·31 ,,
Breadth of macrosclere	..	..	.. 0·011 ,,
Length of gemmule-spicule	..	..	.. 0·009 ,,
Diameter of lower rotule of gemmule-spicule			.. 0·011 ,,

Type-specimen. No. ZEV. 7183/7, Zool. Survey of India (*Ind. Mus.*).

Locality. Shore of Si Dong Ding I., Tai-Hu, Kiangsu Province, China.

The sculpture of the gemmule-spicules distinguishes this species from any other with which I am acquainted. The dried masses of gemmules were not distinguished in the field from similar masses of the gemmules of *Spongilla stanleyi* with which they occurred.

C. Malayan Species.

The only freshwater sponge hitherto recorded from the Malay Peninsula is *Ephydatia blembingia*,[1] Evans from Legeh in the interior of the Siamese Peninsular province of Patani. No species has yet been found in the Federated Malay States or the Straits Settlements. It is improbable that the Spongillidae are entirely absent from the southern parts of the Peninsula, but Dr. Evans found only one species in Peninsular Siam in 1899, Mr. Robinson and I only a few indeterminate specimens in 1901-1902, and I failed to find any at all in apparently favourable localities at Penang and Singapore in 1915 and 1916. There can be no doubt, therefore, that in most parts of Malaya, as in Ceylon,[2] some unknown obstacle to the growth of sponges is wide-spread in fresh water. In the basin of the inner lake of the Talé Sap I found specimens of three species, all of which were, however, scarce. Four species are, therefore, now known to occur in the eastern Peninsular provinces of Siam.

List of Species of Malay Peninsula :—

Spongilla (*Euspongilla*) *lacustris*, auct.

Spongilla (*Euspongilla*) *nana*, Annandale.

Spongilla (*Eunapius*) *potamolepis*, sp. nov.

Ephydatia blembingia, Evans.

The first of these sponges is of course cosmopolitan, the second had been found hitherto only in brackish water in the Chilka Lake on the east coast of India, the third is a very distinct new species, and the fourth is known only from a single small pool (a deserted gold-mine) in Peninsular Siam. *S. nana* is, however, closely allied to *S. alba*, the range of which extends from India to Egypt, while *E. blembingia* is by no means remotely related to *E. bogorensis*,[3] Weber, recorded from Java, Celebes and northern China.

Family SPONGILLIDAE.

Genus **Spongilla**, Lamarck.

Subgenus **Euspongilla**, Vejdovsky.

Spongilla lacustris, auctorum.

(Plate II, fig. 4.)

1910. *Spongilla* (*Euspongilla*) *lacustris*, Annandale, *Rec. Ind. Mus.*, V, p. 197.
1915. *Spongilla lacustris*, *id.*, *Mem. Ind. Mus.*, V, p. 26.
1916. *Spongilla lacustris*, Annandale and Kawamura, *op. cit.*, p. 3, pl. i, figs 1-3.

If we include in this species the forms I have described under the name *proliferens* and *reticulata* it is evidently as wide-spread in Eastern Asia as it is in the Holarctic Zone. Kawamura and I (1916) have recently figured the forms it assumes in Lake Biwa in Japan and I have already recorded (1910) its occurrence in Western China. Specimens from the Talé Sap in Peninsular Siam, though they possess certain peculiar characters, must also be assigned provisionally to the species.

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[1] Evans, *Quart. Journ. Microsc. Sci. London*, XLIV, p. 81 (1901).
[2] Annandale, *Spolia Zeylanica*, VIII, p. 133 (1912).
[3] Weber, *Zool. Ergebn. Res. Neid. Ost.-Ind.*, I, p. 33 (1890).

These specimens consist of several dried fragments found lying in a field at the edge of the inner lake near Pak Payum (see map on p. 6 of this volume). They had evidently been torn from their support and cast up on the field by a flood that had occurred some weeks previous to my visit. The basal membrane, which seems to have been attached to a branch or a rough stone, is intact but the epidermal membrane has entirely disappeared. The sponge is hard and rather brittle, the skeleton comparatively stout. Most of the skeleton-spicules are normal, but many have one or more annular swellings. All are otherwise smooth. The flesh-spicules, which are numerous, are slender, closely and regularly spinned in the middle but smooth or nearly smooth at the ends. The form of the spicules is well shown in text-figure 1. There are no gemmules. There is no trace of buds on the surface of the sponge, which bears short irregular branches or prominences. The specimens were bright green when found, but the colour has faded somewhat.

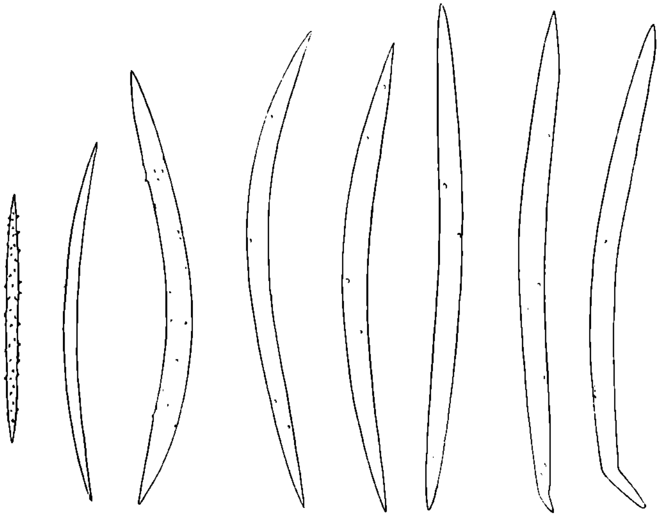

FIG. 5.—Spicules of *Spongilla nana* from Patalung. × 250.

Spongilla nana, Annandale.

1915. *Spongilla nana*, Annandale, *Mem. Ind. Mus.*, V, pp. 31. 32, fig. 3, pl. iv, fig. 3.

Several minute cushion-shaped sponges attached to twigs from the mouth of the Patalung river at Lampam belong to the species recently described from the Chilka Lake. Their spicules, however, differ slightly from those of the type-specimen. Compare fig. 2 on this page with that printed on p. 31 of the paper cited above. A few gemmules were present.

Spongilla potamolepis, sp. nov.

(Plate II, fig. 5.)

The sponge forms a crust from 2 to 3 mm. thick on sticks and bamboos. It is very hard and not at all brittle. The external surface is smooth and there are no branches. The oscula are small and scattered; each is approached by a ramifying horizontal subdermal channel into the floor of which the main exhalent channels open. The colour is brownish or clay-coloured.

The gemmules form a pavement-layer at the base of the sponge or are arranged in small groups which adhere tightly to the object to which the sponge is attached. Each gemmule is small (0·68 mm. in diameter) and subspherical and has a single foraminal tubercle, which is situated in the middle of the upper surface. The pneumatic layer is fairly thick but rather irregular; its cells are small but well-defined. The gemmules are of a dark brown colour.

The skeleton is extremely compact and hard, resembling that of *Potamolepis*, Marshall: it consists of a close network of single spicules and bundles of spicules with interstices that are polygonal both in vertical and in transverse sections. There are

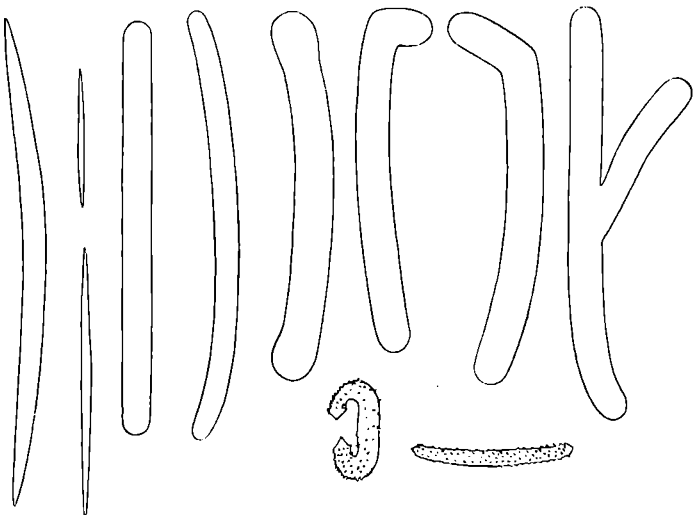

FIG. 6.—Spicules of *Spongilla potamolepis*, × 250.

no well-defined spicule-fibres, but there seems to be a fairly, but diffuse secretion of horny matter at the nodes of the skeleton. There is very little if any inhalent subdermal cavity.

The skeleton-spicules are all smooth and at least moderately stout but vary greatly in shape. In the older parts of the largest specimen I have examined the majority are amphistrongylous and often a little inflated at the extremities. In less well-developed sponges, though similar spicules can be discovered, the majority of the macroscleres are both longer and more slender; they are still distinctly amphystrongylous but not inflated at the tips. Spicules of this type are gradually replaced towards the periphery of young sponges by amphioxi sometimes considerably longer than themselves. We may thus find a single sponge with spicules that are from 9 to 20 times as long as thick. The longest amphioxi are about 0·32 mm. long and the shortest amphistrongyli 0·24 mm. long. There are no flesh-spicules. The gemmule-spicules, which form an irregular mass outside the pneumatic layer of the gemmules, are short, fairly stout and cylindrical, densely covered with minute spicules and as a rule abruptly pointed at the extremities. Occasionally they are sigmatoid but in most cases the main axis is feebly curved.

Type-specimen. ZEV 7164/7, Zool. Survey of India (*Ind. Mus.*).

Locality. Mouth of the Patalung R. at Lampam, Talé Sap, Siam.

My largest specimen of this sponge (Pl. II, fig. 5) was attached to a branch which had been cast up by a flood at the edge of the Talé Sap near Lampam, and is about 30 cm. long and 3 cm. thick including the twig in the middle. It was discovered in a dry condition. Smaller specimens were found growing on bamboo piles inside the river at the same place.

Had I found the large specimen only I should certainly have assigned it to the tropical African genus *Potamolepis*, for it contains no gemmules and in all other respects conforms to the original description of that genus. Further, I was long in doubt as to the specific identity of the different specimens, until I discovered that the peripheral parts of some of them, having amphioxous spicules, merged gradually without a break into thicker regions in which the spicules were amphistrongylous. This species, therefore, provides additional evidence as to the provisional nature of the classification of the Spongillidae that I put forward in 1913, fully recognizing that it was provisional. *Spongilla* (*Eunapius*) *nitens*, a tropical African species, is undoubtedly a close ally of *S. potamolepis*, and I should not be surprised to discover ultimately that some or all of the sponges now assigned to the genus *Potamolepis* will have to be transferred ultimately to the subgenus *Eunapius* of the genus *Spongilla*, the name *Eunapius* having a priority of sixteen years. The only generic basis on which *Potamolepis* now rests is the fact that gemmules have not been discovered in the few specimens that have been collected, and, as I pointed out in 1913 (*op. cit.*, p. 83), it is by no means inprobable that any gemmules they may have contained were left behind adhering to the object to which they were attached. The gemmules of *S. potamolepis* adhere in this way.

LIST OF THE SPONGILLIDAE OF ASIA (INCLUDING THE MALAY ARCHIPELAGO) WITH SYNONYMS.

Genus **Spongilla**, Lamarck (1836).

Subgenus **Euspongilla**, Vejdovsky (1883).

SPONGILLA LACUSTRIS, auct.	Cosmopolitan.
Syn. *Spongilla cinerea*, Weber (not Carter).	
S. LACUSTRIS *var.* PROLIFERENS, Annandale.	India and Burma.
Syn. *Spongilla proliferens*, Annandale.	
S. LACUSTRIS *var.* RETICULATA, Annandale.	India and Burma.

Syn. *Spongilla reticulata*, Annandale.	
SPONGILLA ARCTICA, Annandale.	North Siberia.
SPONGILLA MICROSCLERIFERA, Annandale.	Philippines.
SPONGILLA ALBA, Carter.	India: Egypt.
Syn. *Spongilla cerebellata*, Bowerbank: *Spongilla alba* var. *bengalensis*, Annandale: *Spongilla travancorica*, Annandale.	
SPONGILLA NANA, Annandale.	Peninsular India: Malaya.
SPONGILLA PHILIPPINENSIS, Annandale.	Philippines.
SPONGILLA CINEREA,[1] Carter.	Peninsular India.
SPONGILLA MICROGEMMATA, Svartschevsky.	L. Baikal, Siberia.
SPONGILLA INARMATA, Annandale.	Japan.
SPONGILLA HEMEPHYDATIA, Annandale.	Peninsular India.
SPONGILLA CRATERIFORMIS (Potts).	N. America: Peninsular India.
Syn. *Meyenia crateriformis*, Potts.	
SPONGILLA MICRON, Annandale.	N. China.
SPONGILLA SEMISPONGILLA (Annandale.)	Japan: N. China.
Syn. *Ephydatia semispongilla*, Annandale.	

Subgenus **Eunapius**, Gray (1867).

SPONGILLA CARTERI, Carter.	Mauritius: India: Malay Archipelago: (?) Tropical Africa: E. Europe.
Syn. *Spongilla friabilis*? Carter. *Spongilla carteri* varr. *mollis* and *cava*, Annandale.	
SPONGILLA CARTERI *var.* LOBOSA, Annandale.	Travancore, Malabar Zone of Peninsular India.
SPONGILLA GEMMINA, Annandale.	Peninsular India.
SPONGILLA GEEI, Annandale.	N. China.
SPONGILLA POTAMOLEPIS, Annandale.	Malay Peninsula.
SPONGILLA FRAGILIS, Leidy.	Europe: N. America: N. and E. Asia: Australia: S. America.
Syn. *Spongilla lordii*, Bowerbank: *Spongilla contecta*, Noll.: *Spongilla ottavaensis*, Dawson: *Spongilla sibirica*, Dybowski: *Spongilla moriana*, Potts.	

[1] The green mountain form hitherto referred to this species is distinct and will be described shortly in the *Rec. Ind. Mus.*

SPONGILLA FRAGILIS *var.* CALCUTTANA, Annandale.	Gangetic Delta: Shan States.
SPONGILLA FRAGILIS *var.* DECIPIENS, Weber.	Malay Archipelago.
SPONGILLA CRASSISSIMA, Annandale.	Peninsular India.
SPONGILLA CRASSISSIMA *var.* CRASSIOR, Annandale.	Bengal: Assam.

Subgenus **Stratospongilla**, Annandale (1909).

SPONGILLA BOMBAYENSIS, Carter.	Peninsular India: S. Africa.
SPONGILLA BOMBAYENSIS *var.* PNEUMATICA, Annandale.	Lower Himalayas.
SPONGILLA SUMATRANA[1], Weber.	Malay Archipelago: W. India: E. Africa.
SPONGILLA SUMATRANA *var.* INDICA, Annandale.	Peninsular India.
SPONGILLA SUMATRANA *var.* GRAVELYI, Annandale.	Peninsular India.
SPONGILLA CLEMENTIS, Annandale. Syn. *Spongilla yunnanensis*, Annandale.	E. China: Philippines: Japan.
SPONGILLA SINENSIS, Annandale.	N. China.
SPONGILLA STANLEYI, Annandale.	N. China.

Genus **Pectispongilla,** Annandale (1909).

PECTISPONGILLA AUREA, Annandale.	Travancore, Malabar Zone.
PECTISPONGILLA SUBSPINOSA, Annandale.	Cochin, Malabar Zone.
PECTISPONGILLA STELLIFERA, Annandale.	Cochin.

Genus **Ephydatia,** Lamouroux (1816).

EPHYDATIA FLUVIATILIS, auct. Syn. Still uncertain.	Probably almost cosmopolitan.
EPHYDATIA FLUVIATILIS *var.* INTHA, Annandale.	Shan States, Burma.
EPHYDATIA FLUVIATILIS *var.* SYRIACA, Topsent.	Syria and Palestine.
EPHYDATIA FLUVIATILIS *var.* HIMALAYENSIS, Annandale.	Lower Himalayas.
EPHYDATIA FORTIS, Weltner.	Philippines.
EPHYDATIA MULLERI (Lieberkühn).	Europe: N. America: N.E. Asia.
EPHYDATIA MULLERI *var.* JAPONICA (Hilgendorf).	N. America: Japan.
EPHYDATIA MEYENI (Carter). Syn. *Spongilla meyeni*, Carter.	India: Sumatra: N. China.

[1] I have recently obtained specimens in the Bombay Presidency some of which provide evidence that the forms I have named *indica* and *gravelyi* are merely varieties of this species, while others belong to the *forma typica* and yet others to undescribed varieties.

EPHYDATIA RAMSAYI (Haswell).	New South Wales: New Guinea: ? S. America.
Syn. *Meyenia ramsayi*, Haswell.	
EPHYDATIA OLCHONENSIS, Svartevsky.	L. Baikal, Siberia.
EPHYDATIA GORIAEVII, Svartevsky.	L. Baikal, Siberia.
EPHYDATIA BLEMBINGIA, Evans.	Malay Peninsula.
EPHYDATIA BOGORENSIS, Weber.	Java: Celebes: N. China.

Genus **Heteromyenia**, Potts (1881).

HETEROMEYENIA KAWAMURAE, Annandale.	Japan.

Genus **Dosilia**, Gray (1867).

DOSILIA PLUMOSA (CARTER)	Peninsular India.
Syn. *Spongilla plumosa*, Carter.	

Genus **Trochospongilla**, Vejdovsky (1883).

TROCHOSPONGILLA LATOUCHIANA, Annandale.	Gangetic Delta: Burma: N. China.
TROCHOSPONGILLA PHILOTTIANA, Annandale.	Gangetic Delta: Burma.
TROCHOSPONGILLA PENNSYLVANICA. (Potts).	N. America: Peninsular India.
Syn. *Tubella pennsylvanica*, Potts.	
TROCHOSPONGILLA SOL, Annandale.	N. China.

Genus **Tubella**, Carter (1881).

TUBELLA VESPARIUM, v. Martens.	Borneo.
TUBELLA VESPARIOIDES, Annandale.	Tenasserim, Burma.

Genus **Corvospongilla**, Annandale (1911).

CORVOSPONGILLA CAUNTERI, Annandale.	Peninsular India.
CORVOSPONGILLA ULTIMA (Annandale).	Peninsular India.
Syn. *Spongilla ultima*, Annandale.	
CORVOSPONGILLA ULTIMA *var.* SPINOSA, Annandale.	Malabar Zone.
CORVOSPONGILLA BURMANICA (Kirkpatrick)	Burma.
Syn. *Spongilla burmanica*, Kirkpatrick.	
CORVOSPONGILLA BURMANICA *var.* BOMBAYENSIS, Annandale.	Western Peninsular India.

Genus **Nudospongilla**, Annandale (1913).

NUDOSPONGILLA COGGINI (Annandale).	W. China.
Syn. *Spongilla coggini*, Annandale.	
NUDOSPONGILLA SARASINORUM (Weltner)	Celebes.
Syn. *Spongilla* (?) *sarasinorum*, (Weltner.)	

NUDOSPONGILLA MAPPA, Annandale. Palestine.
NUDOSPONGILLA REVERSA, Annandale. Palestine.
NUDOSPONGILLA ASTER, Annandale. Palestine.
NUDOLPONGILLA VASTA (Weltner). Celebes.
Syn. *Spongilla* (?) *vasta*, Weltner.

Genus **Cortispongilla**, Annandale (1913).

CORTISPONGILLA BARROISI (Topsent). L. of Tiberias, Palestine.
Syn. *Potamolepis barroisi*, Topsent.

Genus **Pachydictyum**, Weltner (1901).

PACHYDICTYUM GLOBOSUM, Weltner. L. Posso, Celebes.

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EXPLANATION OF PLATE IX.

Amorphinopsis excavans var. **robinsonii**, var. nov.

FIG. 1.—Thick hand-section of the outer parts (× 11), showing the spicule-fibres, the external layer of small macroscleres and the wide horizontal channels.

Spongilla inarmata, sp. nov.

FIG. 2.—Gemmule in its cage of skeleton-spicules, × 75.

Spongilla conifera, Annandale.

FIG. 3.—Part of the skeleton of a sponge as seen from above, magnified.
FIG. 4.—Lateral view of a gemmule, × 112.
FIG. 5.—Oblique section of a gemmule, × 112. Somewhat diagramatic.

Trochospongilla sol, sp. nov.

FIG. 6.—Gemmules as seen from above, × 75.

PLATE II.

(This plate was issued with part I of the present volume in December, 1916.)

Amorphinopsis excavans var. **robinsonii**, var. nov.

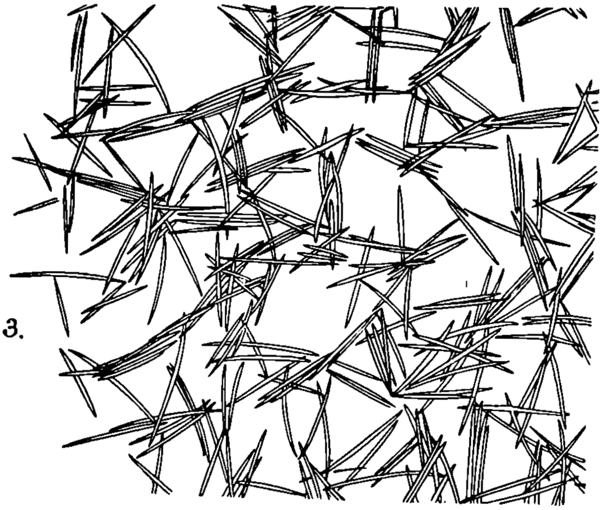
FIG. 3.—A schizotype from Port Weld, showing lacunae in the sponge over the mouths of the burrows of boring molluscs. Nat. Size.

Spongilla lacustris, auct.

FIG. 4.—A fragment from Pak Payum on the Talé Sap. Nat. Size.

Spongilla potamolepis, sp. nov.

FIG. 5.—Type-specimen from Lampam on the Talé Sap. Somewhat reduced.



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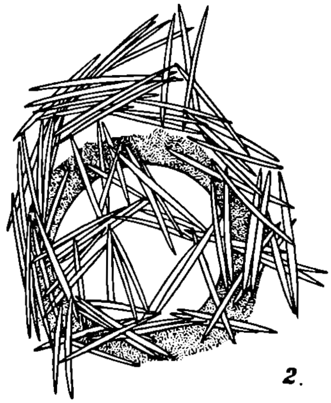

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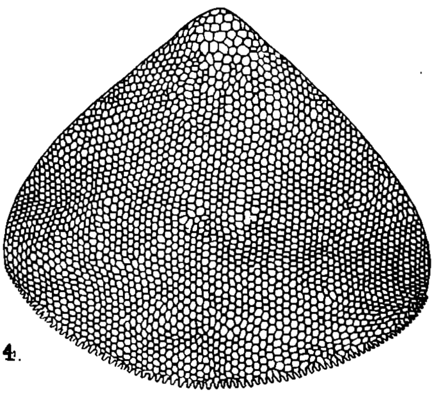

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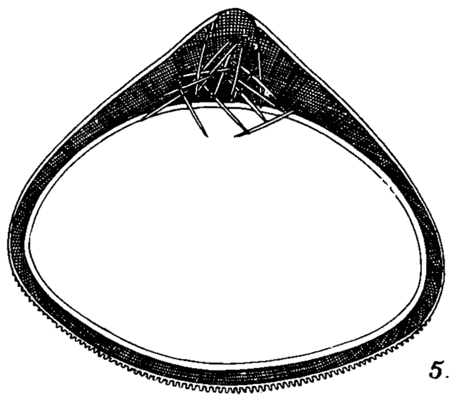

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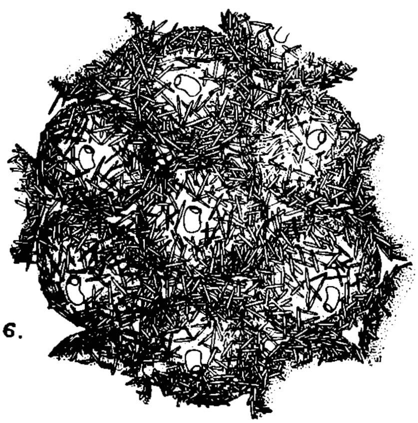

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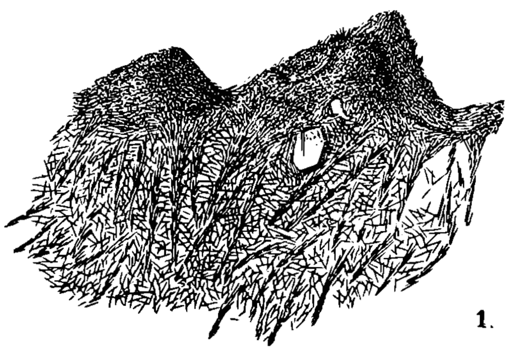

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MEMOIRS

OF THE

ASIATIC SOCIETY OF BENGAL

VOL. VI, pp. 217—320.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

EDITED BY N. ANNANDALE, D.Sc., F.A.S.B.

PART V.

CALCUTTA:
PRINTED AT THE BAPTIST MISSION PRESS, AND PUBLISHED BY
THE ASIATIC SOCIETY, 1, PARK STREET.
1918.

Price Rs. 4; or 6*s*.

11-10-18.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

PART V.

CONTENTS.

Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

CRUSTACEA DECAPODA AND STOMATOPODA.

By STANLEY KEMP, *B.A., F.A.S.B.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

DECAPOD AND STOMATOPOD CRUSTACEA.

By STANLEY KEMP, *B.A., F.A.S.B.*,
Superintendent, Zoological Survey of India.

The collection of Decapoda and Stomatopoda made by Dr. Annandale during his recent tour is one of very great interest and I am much indebted to him for the opportunity of examining it. It contains ninety-five species and subspecies all of which were obtained in fresh or brackish water.

The chief value of the collection lies in the precise information it affords regarding the environment of the different species. Little attention has been paid to this matter hitherto; when doubts arise as to the habitat of a particular form, the published accounts generally prove valueless and even where the most exact details of the locality are given no reference is as a rule made to the salinity of the water. In consequence, the number of forms which have succeeded in establishing themselves in fresh water has probably been much under-estimated; in the collection under consideration members of no less than twelve genera and subgenera were found living far beyond the reach of tidal influence.

The principal object of Dr. Annandale's tour was the investigation of the faunas of three lakes situated in eastern Asia,—Lake Biwa in Japan, the Tai Hu in the Kiangsu province of China, and the Tale Sap on the east coast of Peninsular Siam; maps and brief descriptions of these are given in the Introduction to this volume. The collection of Crustacea was, however, not restricted to the lakes; specimens were obtained in various parts of Japan, at three localities in China and at a number of places in the Malay Peninsula.

The Japanese collection contains examples of nine species and one subspecies, namely:—

Eriocheir japonicus (de Haan).
Sesarma dehaani (Milne-Edwards).
Helice tridens, de Haan.
Potamon (*Geotelphusa*) *dehaani* (White).
Palaemon nipponensis, de Haan.
Leander paucidens (de Haan).
Caridina denticulata (de Haan).
Paratya compressa (de Haan).
,, ,, subsp. *improvisa*, Kemp.
Acetes japonicus, Kishinouye.

Helice tridens and *Acetes japonicus* probably came from water that was slightly brackish; all the remainder were found in pure fresh water. The only Decapods actually found in Lake Biwa are the three prawns *Leander paucidens*, *Caridina denticulata*, and *Paratya compressa*, but the crabs *Eriocheir japonicus* and *Potamon dehaani* are said to enter the lake at times.

Since 1849, when the concluding part of de Haan's magnificent work on Japanese Decapod Crustacea was published, a considerable number of important papers on the same subject have appeared, notable contributions having been made by Doflein, Miss Rathbun, de Man and Balss. The present collection does not in consequence make any striking addition to our knowledge of the non-marine forms, though it has been possible to demonstrate the existence in the main island of Japan of two distinct races of *Xiphocaridina* (more correctly *Paratya*) *compressa*.

Compared with Japan, China is from a carcinological point of view almost unknown and the collections from this country are in consequence of very great interest. Sixteen species were found in three distinct localities, all having been obtained in pure fresh water.

TAI HU LAKE, KIANGSU PROVINCE.

Rhynchoplax introversus, Kemp.
Eriocheir sinensis (Milne-Edwards).
Potamon (*Potamon*) *denticulatum* (Milne-Edwards).
Palaemon nipponensis, de Haan.
,, *asperulus*, von Martens.
Leander modestus, Heller.
Caridina denticulata, subsp. *sinensis*, nov.

SHANGHAI AND THE WHANGPOO RIVER.

Tympanomerus deschampsi, Rathbun.
Eriocheir sinensis (Milne-Edwards).
,, *leptognathus*, Rathbun.
Sesarma intermedium (de Haan).
Sesarma dehaani, Milne-Edwards.
Leander annandalei, Kemp.
,, *modestus*, Heller.
Palaemonetes sinensis (Sollaud).
Caridina nilotica subsp. *gracilipes*, de Man.

THE PEAK, HONGKONG.

Potamon (*Potamon*) *anacoluthon*, sp. nov.
Caridina serrata, Stimpson.

It will be noticed that nine genera are represented in this collection, a very large number when it is remembered that all were found in fresh water. Three species and one subspecies had not previously been described; of these the *Rhynchoplax* is interesting in view of its habitat, while the *Leander* is of considerable importance in that it represents a type intermediate between Henderson's very remarkable *L. tenuipes* and the more normal members of the genus. *Tympanomerus deschampsi*, *Eriocheir leptognathus* and *Palaemonetes sinensis* are species only recently discovered; but our knowledge of *Palaemon asperulus*, *Leander modestus*, and *Caridina serrata* has hitherto rested on descriptions made more than fifty years ago. *Caridina nilotica* subsp. *gracilipes* is recorded far to the north of its previously known range and evidence is brought forward to show that the Chinese form of *Caridina denticulata* differs sufficiently from that found in Japan to warrant subspecific recognition.

The only species in Dr. Annandale's collections common to both China and Japan are *Sesarma dehaani* and *Palaemon nipponensis*.

The collection from the Tale Sap, a lagoon connected with the Gulf of Siam by means of a comparatively narrow channel, contains the largest number of species, forty-seven forms being represented. At the mouth of the Patalung river and in the inner of the two lakes of which the Tale Sap is composed, the water was fresh at the time when the collection was made and probably remains so throughout the year. In the channel between the two lakes and in the outer lake it was brackish, specific gravities falling between 1·0015 and 1·0085.[1]

The following species were obtained in these two regions :—

Patalung River and inner lake of Tale Sap.

Fresh water.

Paratelphusa (*Paratelphusa*) *germaini* (Rathbun).
Palaemon carcinus, Fabricius.
,, *lanchesteri*, de Man.
Palaemon elegans, de Man.
Caridina propinqua, de Man.
,, *gracillima*, Lanchester.
,, *nilotica*, subsp. *macrophora*, nov.

Outer lake of Tale Sap and channel between lakes.

Brackish water.

Rhynchoplax exiguus, Kemp.
Gelasimus annulipes, Latreille.
Dotilla wichmanni, de Man.
Camptandrium sexdentatum, Stimpson.
Grapsus strigosus (Herbst).
Metopograpsus messor (Forskål).
,, *maculatus*, Milne-Edwards.
Varuna litterata (Fabricius).
Sesarma quadratum (Fabricius).
,, *haswelli*, de Man.
,, *taeniolatum*, White.
,, *siamense*, Rathbun.
Pilumnus quadridentatus, de Man.
Scylla serrata (Forskål).
Neptunus pelagicus (Linn.).
Charybdis crucifera (A. Milne-Edwards).
,, *affinis*, Dana.
,, *callianassa* (Herbst).
Ebalia heterochalaza, sp. nov.
Philyra sexangula, Alcock.
,, *olivacea*, Rathbun.
Dorippe astuta, Fabricius.
Clibanarius longitarsis (de Haan).
Diogenes avarus, Heller.
Upogebia (*Upogebia*) *heterocheir*, Kemp.
Palaemon carcinus, Fabricius.
,, *sundaicus* (Heller), de Man.
Alpheus paludicola, Kemp.
Caridina propinqua, de Man.
,, *gracillima*, Lanchester.
Penaeus indicus, var. *merguiensis*, de Man.
,, *carinatus*, Dana.
Penaeopsis monoceros (Fabricius).
,, *affinis* (Milne-Edwards).
,, *brevicornis* (Milne-Edwards).
Acetes indicus, Milne-Edwards.
,, *japonicus*, Kishinouye.
Lucifer hanseni, Nobili.
Squilla scorpio, Latreille.
,, ,, var. *immaculata*, Kemp.
,, *nepa*, Latreille (Bigelow).
,, *interrupta*, Kemp.
Squilla raphidea, Fabricius.

It is probable that a considerable number of the brackish-water forms are merely casual or seasonal immigrants to the lake and do not inhabit it permanently; the fact

[1] Nearly all the species were found in water the specific gravity of which varied from 1·0035 to 1·0085 (corrected).

that the specimens were all collected at one season renders it impossible to determine the precise status of individual species in this respect. It is none the less possible to institute a comparison with the Decapod and Stomatopod fauna of the Chilka Lake on the Orissa coast of the Bay of Bengal. The two lagoons are in many respects closely similar: both are shallow, with a muddy bottom, both are connected with the sea and it is practically certain that in the outer part of the Tale Sap, as in the Chilka Lake, the salinity of the water varies considerably at different times of the year. One essential difference must be noted,—that in no part of the Chilka Lake does the water remain permanently fresh; but this discrepancy may be obviated by considering for comparative purposes only the fauna of the outer lake of the Tale Sap.

Of the forty-one species of Decapods and Stomatopods which we regarded as permanent inhabitants of the Chilka Lake fifteen were found in the Tale Sap, namely :—

Camptandrium sexdentatum, Stimpson.	*Alpheus paludicola*, Kemp.
Varuna litterata (Fabricius).	*Caridina propinqua*, de Man.
Scylla serrata (Forskål).	*Penaeus carinatus*, Dana.
Neptunus pelagicus (Linn.).	*Penaeopsis monoceros* (Fabricius).
Clibanarius longitarsis (de Haan).	,, *affinis* (Milne-Edwards).
Diogenes avarus, Heller.	*Lucifer hanseni*, Nobili.
Upogebia (*Upogebia*) *heterocheir*, Kemp.	*Squilla scorpio*, Latreille.

Squilla scorpio var. *immaculata*, Kemp.

The majority of these are species of very wide distribution, found in the open sea as well as in backwaters, and are consequently of little importance for comparative purposes. The occurrence of *Camptandrium sexdentatum*, *Upogebia heterocheir*, *Alpheus paludicola* and *Caridina propinqua* appears, however, to indicate a real relationship between the two faunas; it is also noteworthy that the species of two Oxystome genera found in the Tale Sap are closely allied to those obtained in the Chilka Lake. The fauna of the Tale Sap, like that of the Chilka Lake, has little in common with that of the Gangetic Delta, though the delta occupies a position intermediate between the two lagoons so far as the coast-line is concerned.

The Tale Sap collection is not rich in undescribed species but in a number of cases considerable additions are made to our knowledge of the geographical distribution.

The collection also contains a number of species found about fifty miles to the south-east of the Tale Sap in the Patani river, below the town of Patani in the Siamese Malay States. These specimens belong to sixteen species and were all obtained in water that at the time of their capture was quite fresh; the situation in which they were found was, however, subject to tidal influence and there can be no doubt that all the species are at times brought into contact with brackish water. The following forms were found in the Patani river :—

Varuna litterata (Fabricius).
Pyxidognathus deianira, de Man.
Sesarma edwardsi, de Man.
,, *siamense*, Rathbun.
Clistocoeloma merguiense, de Man.
Palaemon carcinus, Fabricius.
,, *sundaicus* (Heller), de Man.
,, *lampropus*, de Man.
Leander potamiscus, Kemp.
Caridina propinqua, de Man.
,, *brachydactyla*, subsp. *peninsularis*, nov.
,, *gracilirostris*, de Man.
,, *weberi*, subsp. *sumatrensis*, de Man.
Acetes erythraeus, Nobili.
Acetes japonicus, Kishinouye.

A number of these species were also obtained in the Tale Sap. The most interesting are the scarce *Pyxidognathus deianira*, the *Leander* and the subspecies of *Caridina brachydactyla*, a species that in its typical form is known only from Celebes, Flores and Saleyer.

In ditches in the vicinity of the Patani river *Paratelphusa germaini* (Rathbun) was found.

Dr. Annandale also made a small collection at Penang. Six species were obtained on the island, for the most part in a hill stream in the Botanical Gardens, and six at the mouth of the Prai river on the mainland opposite Penang ; the latter were found in water of considerable salinity. The species are :—

Penang Island.

Sesarma sp.
Potamon (*Potamon*) *stoliczkanum* (Wood-Mason).
Palaemon neglectus, de Man.
Leander potamiscus, Kemp.
Caridina brachydactyla, subsp. *peninsularis*, nov.
Caridina weberi, subsp. *sumatrensis*, de Man.

Mouth of Prai River.

Metopograpsus maculatus, Milne-Edwards.
,, *quadridentatus*, Stimpson.
Myomenippe granulosa (A. Milne-Edwards).
Clibanarius padavensis, de Man.
Leander semmelinki, de Man.
Acetes erythraeus, Nobili.

In addition there are single examples of *Paratelphusa* (*Paratelphusa*) *incerta*, Lanchester, from the Singapore Botanical Gardens and of *Sesarma andersoni*, de Man, from Kantan in Trang.

To my account of this extensive collection I have added a description of a very interesting Grapsid (*Sesarma foxi*) presented to the Indian Museum by Mr. B. H. Buxton and obtained at the unusual altitude of 2000 ft. on Langkawi I. off the west coast of the Malay Peninsula. Reference is also made to a Javanese collection of Decapods, comprising six species, kindly obtained for us by the late Dr. W. C. Hossack. All these had already been recorded from the island by Dr. J. G. de Man.

In dealing with certain groups of species concerning which our knowledge was more than ordinarily deficient, I have found it advantageous to work through portions of the undetermined material lying in the Indian Museum and to present the results concurrently with those derived from Dr. Annandale's collection. The literature of the subject being so widely scattered I have found that a great economy in time is effected by this procedure, and the conclusions reached are, I believe, of much greater value than if either collection had been examined separately. The groups treated in this manner are (i) the Hymenosomatidae, (ii) the species of *Leander* allied to *L. styliferus*, Milne-Edwards, (iii) the Atyid genus *Paratya* (= *Xiphocaridina*) and (iv) the Penaeid genus *Acetes*. On these groups separate reports, including descriptions of a number of the new species, have been already published in Vol. XIII of the *Records of the Indian Museum*.

Dr. Annandale has generously presented a complete set of the specimens he obtained, together with the types of the new species and subspecies to the collection of the Zoological Survey of India (Indian Museum).

Family HYMENOSOMATIDAE.

In the course of his tour Dr. Annandale obtained two species of this interesting family, both apparently new. Descriptions of these forms have been published in Vol. XIII of the *Records of the Indian Museum* in a paper devoted mainly to the elucidation of the Indian representatives of the family. In this paper I have attempted a revision of the genera and have pointed out that the Indian species referred by Alcock to *Hymenicus* should more properly be grouped under Stimpson's *Rhynchoplax*. Dana's *Hymenicus* is in my opinion synonymous with White's *Halicarcinus*.

It is unfortunate that both Dr. Tesch and I should have been occupied with this family at the same time without knowledge of each other's work. Tesch's report on certain crabs obtained by the 'Siboga' Expedition, published only five months after my own paper, also contains a revision of the genera of this family. In the application of *Rhynchoplax* we are, for the most part, in agreement[1]; but Tesch retains *Hymenicus* as a distinct genus and in less important details our work shows a number of discrepancies.

Rhynchoplax introversus, Kemp.

1917. *Rhynchoplax introversus*, Kemp, *Rec. Ind. Mus.*, XIII, p. 262, figs. 11*a-c*.

This species, which is readily distinguished from any other by the peculiar form of the lateral border of the carapace, is based on two specimens obtained in the Tai-Hu lake in China, living in water that is quite fresh at all seasons of the year. The only other Hymenosomatid known from fresh water beyond the reach of all tidal influence is *Halicarcinus lacustris* (Chilton)[2] which has been recorded from Australia, New Zealand and Norfolk I.

[1] Dr. Tesch places Hess's *H. Kreffti* and Haswell's *H. rostrata* under *Rhynchoplax*. According to my views both these species are to be referred to *Halicarcinus* or, if it really be distinct from the latter, to *Hymenicus*. This is certainly true of Haswell's species of which I have seen specimens.

[2] Chilton, *Trans. N. Zealand Inst.*, XLIV, p. 128 (1912).

Rhynchoplax exiguus, Kemp.

1917. *Rhynchoplax exiguus*, Kemp, *Rec. Ind. Mus.*, XIII, p 260, fig. 10.

. A very small species without any strongly marked characteristics. Ten specimens were found by Dr. Annandale in the outer part of the Tale Sap, on the mainland opposite the western end of Koh Yaw. They were living in lumps of turf that had fallen into the lake owing to the undermining of the banks. The specific gravity of the water was about 1·00625.

Family OCYPODIDAE.

Subfamily *OCYPODINAE*.

Genus **Gelasimus**, Latreille.

Gelasimus annulipes, Latreille (Milne-Edwards).

1900. *Gelasimus annulipes*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 353.
1915. *Gelasimus annulipes*, Kemp, *Mem. Ind. Mus.*, V, p. 221.

A colony of this abundant species was found by Dr. Annandale at Kaw Deng at the mouth of the Tale Sap. The claws of large males were of a pale dull yellow colour in life. No specimens were observed more than a few hundred yards within the mouth of the lake, the water being practically as salt as that of the Gulf of Siam.

Subfamily *SCOPIMERINAE*.

Genus **Dotilla**, Stimpson.

Dotilla wichmanni, de Man.

1892. *Dotilla wichmanni*, de Man, in Weber's *Zool. Ergebn. Reise Niederland. Ost-Ind.*, II, p. 308, pl. xviii, fig. 8.
1895. *Dotilla wichmanni*, de Man, *Zool. Jahrb.*, *Syst.*, VIII, p. 577.
1910. *Dotilla wichmanni*, Rathbun, *Dansk. Vid. Selsk. Skrift.* (7), *Naturvid. og Math.*, V, p. 324.
1918. *Dotilla wichmanni*, Tesch, *Decap. Brachyur.* '*Siboga*'-*Exped.*, I, p. 45.

A large number of specimens were obtained at Kaw Deng at the mouth of the Tale Sap on the opposite side of the channel from Singgora.

The series includes some very fine individuals with carapace nearly 8 mm. in length and consequently much larger than any of de Man's original specimens, none of which exceeded 5 mm. In males between 6 and 8 mm. in length the carapace bears three large angular projections on either side; two of these are situated, one behind the other, on the outer side of the deep groove that borders the lateral margin, while the third, which is more spinose in character and possesses a corneous apex is situated on the side-wall, immediately beneath the small tooth that defines the upper and outer limit of the orbit (text-fig. 1). These projections are not seen in females or small males.

In large males, also, there is a short but high ridge on the inner face of the carpus, situated close to the meral articulation and easily visible in dorsal view. There is no great difference between large and small specimens in the form of the fingers of the chela, the largest examples possessing merely a low crest in the middle of the dactylus.

De Man compares this species with *D. sulcata* and remarks (p. 311) "Das sternum ist überall glatt und zeigt nicht die für *D. fenestrata* characteristischen, durchsichtigen stellen ; während aber die einzelnen segmenten bei *D. sulcata* leicht convex erscheinen, sind sie bei der neuen Art stark abgeflacht oder leicht concav, sowie deutlich gerändert." On comparing the species with *D. myctiroides* it is, however, evident that the slightly concave areas that occur on each sternal segment and occupy nearly the whole of the space between the legs and the abdomen are true 'tympana' and that so far as the sternum is concerned the difference between *D. wichmanni* and Hilgendorf's *D. fenestrata* rests merely in the number of segments on which 'tympana' are found.

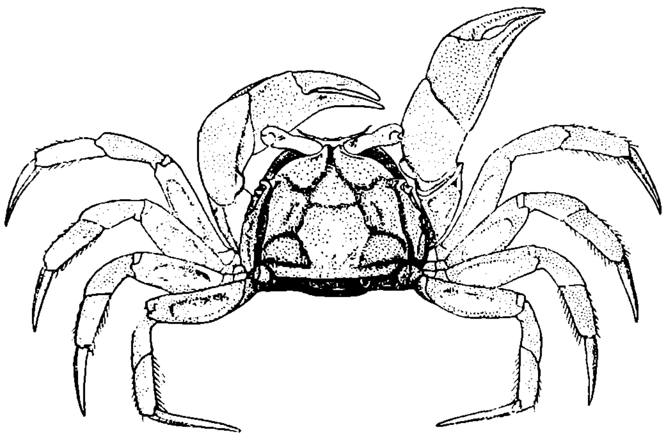

FIG. 1.—*Dotilla wichmanni*, de Man.
Adult male.

Dr. Annandale notes that the 'runs' made by this species are not so carefully constructed and the pellets of sand not so tidily arranged as is the case with the species found living on the western side of the Bay of Bengal.

Dotilla wichmanni has not hitherto been recorded from Indian waters, but has, however, recently been obtained in the Andaman Is. The specimens, none of which are of large size, were found living on the sandy shores of Corbyn's Cove South, not far from Port Blair. The species has been reported from Celebes, Makassar and Atjeh in Sumatra (de Man), the Talaut Is. (Tesch) and from the coast of Koh Kong in the Gulf of Siam (Rathbun).

Genus **Tympanomerus**, Rathbun.

Tympanomerus deschampsi, Rathbun.

1914. *Tympanomerus deschampsi*, Rathbun, *Proc. U. S. Nat. Mus.*, XLVI, p. 356, pl. xxxii, pl. xxxiii, fig. 1.

A single female with carapace 9½ mm. in breadth was obtained by Dr. Annandale at the edge of the Whangpoo R., 5 to 10 miles below Shanghai. It was found in a burrow above the water-line in mud which was rapidly hardening. The water in the river at the point where the specimen was taken is quite fresh at all seasons.

The species is readily distinguished from *T. stapletoni*, de Man, by the characters given by Miss Rathbun ; it has been recorded from Shanghai, where the type specimens were obtained, and from Korea.

Subfamily *MACROPHTHALMINAE*.

Genus **Camptandrium**, Stimpson.

Camptandrium sexdentatum, Stimpson.

1907. *Camptandrium sexdentatum*, Stimpson, *Smiths. Misc. Coll.*, XLIX, p. 138, pl. xvii, fig. 4.
1915. *Camptandrium sexdentatum*, Kemp, *Mem. Ind. Mus.*, V, p. 236, pl. xii, fig. 6.
1918. *Camptandrium sexdentatum*, Tesch, *Decap. Brachyur. 'Siboga'-Exped.*, I, p 65, pl. v, fig. 3.

Dr. Tesch has recently redescribed this species. In the account which I published in 1915 I placed the genus in the Grapsidae and in the subfamily Varuninae, being under the impression that it was remotely allied to *Eriocheir*. Dr. Tesch, who has had the advantage of examining an adult male, considers that it belongs to the Ocypodidae and to the subfamily Macrophthalminae and is not distantly related to *Paracleistostoma*. With this view I concur.

Two females of this rare species, with carapace 7·2 and 6·7 mm. in breadth, were found by Dr. Annandale in the Tale Sap. They are a trifle smaller than the dead female found in the Chilka Lake (*v.* Kemp, *loc. cit.*, text-fig. 13) ; the sculpture of the carapace is crisper, the transverse ridge on the branchial and cardiac regions being more sharply defined and the antero-lateral teeth more prominent.

The specimens were found in the channel opposite Singgora on a bottom of mud and dead shells at a depth of 4½ metres and in the middle of the outer lake, N. of Koh Yaw, on a bottom of sticky mud at a depth of 2½ metres. The specific gravity of the water in the former locality was 1·00625 and in the latter 1·0035 (corrected).

The species has been recorded from Hong Kong (Stimpson), the Bay of Batavia (Tesch), the Chilka Lake, Orissa (Kemp) and Ennur backwater, Madras (Kemp).

Family GRAPSIDAE.

Subfamily *GRAPSINAE*.

Genus **Grapsus**, Lamarck.

Grapsus strigosus, (Herbst).

1900. *Grapsus strigosus*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 393.

A single dead specimen with carapace 34 mm. in breadth was found at the mouth of the Tale Sap. The species is probably not an inhabitant of the lake.

Genus **Metopograpsus,** Milne-Edwards.

Metopograpsus messor, (Forskål) Milne-Edwards.

1900. *Metopograpsus messor,* Alcock, *Journ. Asiat. Soc. Bengal,* LXIX, p. 397.
1918. *Metopograpsus messor,* Tesch, *Decap. Brachyur. 'Siboga'-Exped.,* I, p. 79.

Two dead specimens were found at Kaw Deng at the mouth of the Tale Sap. The carapace of the largest is 20 mm. in breadth.

Metopograpsus maculatus, Milne-Edwards.

1900. *Metopograpsus maculatus,* Alcock, *Journ. Asiat. Soc. Bengal,* LXIX, p. 398.
1918. *Metopograpsus maculatus,* Tesch, *Decap. Brachyur. 'Siboga'-Exped.,* I, p. 80.

Two examples of this species, including an ovigerous female with carapace 22 mm. in breadth, were obtained at the mouth of the Prai River, on the mainland opposite Penang; they were living under stones on a mud flat exposed at low water. Two others were found under stones on the shore of Koh Yaw in the outer lake of the Tale Sap. The specific gravity of the water at the latter place (corrected) was 1·00625.

Metopograpsus quadridentatus, Stimpson.

1858. *Metopograpsus quadridentatus,* Stimpson, *Proc. Acad. Sci. Philadelphia,* p. 102.
1883. *Metopograpsus quadridentatus,* de Man, *Notes Leyden Mus.,* V, p. 158.
1895. *Metopograpsus quadridentatus,* de Man, *Zool. Jahrb., Syst.,* IX, p. 76, fig. 16.
1901. *Metopograpsus quadridentatus,* Nobili, *Boll. Mus. Torino,* XVI, no. 397, p. 3.
1907. *Metopograpsus quadridentatus,* Stimpson, *Smiths. Misc. Coll.,* XLIX, p. 115, pl. xvi, fig. 2.
1910. *Metopograpsus quadridentatus,* Rathbun, *Danske Vid. Selsk. Skrift.* (7), *naturvid. og math.,* V, p. 325.
1918. *Metopograpsus quadridentatus,* Tesch, *Decap. Brachyur. 'Siboga'-Exped.,* I, p. 79.

Five specimens were found in company with *M. maculatus* at the mouth of the Prai River near Penang. In the largest example, a male with carapace 20·5 mm. in length and 24·75 mm. in breadth, the chela precisely resembles the figure given by de Man (*loc. cit.,* 1895).

M. quadridentatus has not so far been found in Indian waters. It has been recorded from Macao (Stimpson), Amoy (de Man), 'Malacca' (de Man), Borneo (Nobili) and from the east coast of the Gulf of Siam (Rathbun).

Subfamily *VARUNINAE.*

Genus **Varuna,** Milne-Edwards.

Varuna litterata (Fabr.), Milne-Edwards.

1900. *Varuna litterata,* Alcock, *Journ. Asiat. Soc. Bengal,* LXIX, p. 401.
1915. *Varuna litterata,* Kemp, *Mem. Ind. Mus.,* V, p. 232.

Several specimens were obtained in the outer lake of the Tale Sap, at and near Singgora and at Koh Yaw. They were found in fishermen's nets, under stones on the shore, and in pools and ditches. The specific gravity of the water in which they were taken varied from about 1·004 to 1·0085 (corrected). Crabs of this species were also taken in the Patani River, fifty miles to the south-east of the Tale Sap, in water that was quite fresh, though subject to tidal influence.

Genus **Eriocheir**, de Haan.

Eriocheir japonicus (de Haan).

1835. *Grapsus (Eriocheir) japonicus*, de Haan, in Siebold's *Fauna Japonica, Crust.*, p. 59, pl. xvii.

This is the common edible crab of the main island of Japan and is sold in large numbers at Kyoto. It is said to be migratory in habit, making its way towards the sea or into lakes after heavy rain. There is a specimen in the Otsu laboratory from the southern end of Lake Biwa, but Dr. Annandale was unable to find examples in the lake in October and November 1915. Young and half-grown specimens were abundant in the main channel of the Yodo River, just above Osaka, at the beginning of December. The species does not appear to have been found in the sea ; it has occasionally been recorded from brackish water, but is almost always found in water that is quite fresh.

Four very large specimens obtained in the Kyoto market and said to have come from Echizen province to the north of Lake Biwa yield the following measurements (in mm.) :—

	♂	♂	♀	♀
Length of carapace	83	82	67	66
Greatest breadth of carapace ..	94	91	73	72
Length of chelipede	134	130	76	75
Length of chela	82	82	43	43
Breadth of chela	45	44	22	21
Length of second walking leg ..	155	151	123	128

In the largest males the whole palm on both outer and inner sides, except for a small area at the proximal end of the lower surface, is thickly covered with woolly hair, which also invests the anterior margin of the carpus and the base of the dactylus. In other males, with carapace about 38 mm. in length, the hair is less abundant ; the entire lower surface of the palm is bare, on the inner side there is only a comparatively small patch in the neighbourhood of the finger-cleft and there is very little on the anterior margin of the carpus. In males between 11 and 12 mm. in length the chela is apparently nude, but on close inspection is seen to be largely covered with a fine and very close pubescence. In these smallest individuals the carapace is flatter and its antero-lateral margins are straighter than in adults.

Eriocheir sinensis (Milne-Edwards).

1854. *Eriochirus sinensis*, Milne-Edwards, *Arch. Mus. Hist. nat. Paris*, VII, p. 146, pl. ix, figs. 1-1c.

1880. *Eriocheir sinensis*, Kingsley, *Proc. Acad. Sci. Philadelphia*, p. 210.

The collection contains a large male and female from Moo-Too, Tai Hu, Kiangsu province, China, and a number of young individuals obtained in the Whangpoo River, between Shanghai and Woosung at depths of 5½ to 7½ metres. The carapace of the largest specimen is 54 mm. in length.

In young examples, as in *E. japonicus*, the antero-lateral borders of the carapace are much straighter than in adults and there is less hair on the hands. In a male with carapace 15 mm. in length the hair is restricted to the outer surface of the chela and it is completely absent in all specimens under 12 mm. in length. The four teeth on the front are very sharply pointed in adults, but much blunter in young individuals.

Eriocheir rectus[1] (Stimpson) is perhaps merely a synonym of this species. It was described from a specimen 0·92 ins. in length and is chiefly characterised by its straighter lateral margins and blunter frontal lobes, thus closely resembling the young of *E. sinensis*.

Dr. Annandale informs me that this is the common edible crab of Shanghai and is to be found on sale in all the village markets round the Tai Hu, where it is chiefly captured in narrow creeks. Doflein[2] records the species from Shasi on the Yang-tse-kiang, 1300 kilometres from sea, and also from brackish water in the neighbourhood of Shanghai.

Eriocheir leptognathus, Rathbun.

1914. *Eriocheir leptognathus*. Rathbun, *Proc. U. S. Nat. Mus.*, XLVI, p. 353, pl. xxxiii, figs. 2, 3.

To this species I refer a small male with carapace 9·1 mm. in length and 9·6 mm. in breadth. It agrees on the whole very well with Miss Rathbun's description. The edge of the front is almost straight, only very obscurely trilobed, the postero-lateral margins of the carapace are parallel rather than convergent and the hindmost tooth of the antero-lateral border is extremely small and inconspicuous. The outer surface of the palm is bare, as in the type, but there is a dense patch of woolly hair on the inner side, extending on to the base of both fingers.

The granulate ridge, anteriorly concave, that runs inwards from the hindmost tooth of the antero-lateral margin is well marked ; it is finer and less elevated than in *E. japonicus* or *E. sinensis* and in front of it there is no trace of the comparatively deep depression found in those species. There is, moreover, a noticeable distinction in the size of the eyes. If specimens of similar dimensions be compared it will be seen that the cornea is much smaller in *E. leptognathus* than in the two allied species and is decidedly narrower than the basal part of the stalk. The most obvious character in which the species differs from other members of the genus is, however, the presence of only three instead of four teeth on the antero-lateral margin of the carapace ; this feature seems to have escaped Miss Rathbun's attention though it is clearly shown in her figure.

The single specimen was found in company with young *E. sinensis* in the Whangpoo River, between Shanghai and Woosung at a depth of 5½ to 7½ metres. It was found in pure fresh water.

The female described by Miss Rathbun was 10·6 mm. in length and 11·6 mm. in breadth and was obtained at Shanghai.

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1 *Eriochirus rectus*, Stimpson, *Proc. Acad. Nat. Sci., Philadelphia*, X, p. 103 (1858) and *Smiths. Misc. Coll.*, XLIX, p 125 (1907).

2 Doflein, *Abhandl. K. Bayer. Akad. Wiss.*, XXI, p. 665 (1902).

Genus **Pyxidognathus**, A. Milne-Edwards.

Pyxidognathus deianira, de Man.

1888. *Pyxidognathus deianira*, de Man, *Journ. Linn. Soc. Zool.*, XXII, p. 148, pl. x, figs. 4-6.

Dr. Annandale obtained a single specimen of this scarce species among the roots of a dead palm trunk in the Patani River, below the town of Patani in the Siamese Malay States. The individual is a male with carapace 9 mm. in breadth. Except for the slightly more acute teeth on the antero-lateral margin of the carapace, the specimen bears the closest resemblance to two smaller males, co-types of the species, that are preserved in the Indian Museum.

The species has hitherto been recorded only from Mergui, where it was obtained in mangrove swamps.

Subfamily *SESARMINAE*.

Genus **Sesarma**, Say.

Sesarma quadratum (Fabricius).

1887. *Sesarma quadrata*, de Man, *Zool. Jahrb.*, *Syst.*, II, p. 683, pl. xvii, fig. 2.
1890. *Sesarma quadrata*, de Man, *Notes Leyden Mus.*, XII, p. 99.
1892. *Sesarma quadrata*, de Man, in Weber's *Zool. Ergebn. Reise Niederl. Ost-Ind.*, II, p. 328.
1895. *Sesarma* (*Parasesarma*) *quadrata*, de Man, *Zool. Jahrb.*, *Syst.*, IX, p. 182.
1917. *Sesarma* (*Parasesarma*) *plicata*, Tesch, *Zool. Meded. Mus. Leiden*, III, p. 187 (*syn.*).

Several specimens were found at different places in the outer lake of the Tale Sap (Kaw Keoh, Kaw Deng, Koh Yaw and Singgora); they were for the most part found under stones or running on the shore at some distance from the water. All appear to belong to the true *S. quadratum* as redefined by de Man.

Sesarma haswelli, de Man.

1888. *Sesarma haswelli*, de Man, *Journ. Linn. Soc.*, XXII, p. 175.
1917. *Sesarma* (*Chiromantes*) *haswelli*, Tesch, *Zool. Meded. Mus. Leiden*, III, p. 158.

A single example of this species, an ovigerous female 16 mm. in breadth, was obtained by Dr. Annandale near Singgora.

Alcock[1] included *S. haswelli*, along with *S. lividum*, A. Milne-Edwards, and *S. dussumieri*, Milne-Edwards, in his synonymy of *S. bidens* (de Haan), being evidently of the opinion that the five forms distinguished by de Man in 1888 in his "section C" (*loc. cit.*, p. 175) were only based on individual variations of a single wide-spread species. De Man in 1902[2] dissented from Alcock's opinion.

In the Indian Museum are preserved the type of *S. haswelli*, other specimens from Mergui originally determined by de Man as *S. livida*, a large number of examples examined by Alcock and several additional samples obtained in recent years.

On examining this material I find little difficulty in separating it into groups, corresponding to those that de Man and Tesch recognize as distinct species. I have no doubt that Alcock formed a wrong estimate of the variability of the forms included in the *bidens*-group and that it will be necessary to subject the Indian material to a thorough revision.

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[1] Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 415.
[2] De Man, *Abhandl. Senck. naturf. Ges.*, *Frankfurt*, XXV, p. 538 (1902).

It should be noted that the specimens from Mergui, recorded by de Man in 1888 under the name *S. livida*, have since been described by him as a new species—*S. onychophora*.[1]

Sesarma andersoni, de Man.

1888. *Sesarma andersoni*, de Man, *Journ. Linn. Soc.*, XXII, p. 172, pl. xii, figs. 1-4.
1917. *Sesarma* (*Parasesarma*) *andersoni*, Tesch, *Zool. Meded. Mus. Leiden*, III, p. 129.

A single specimen, with carapace 8·6 mm. in breadth, was obtained by Dr. Annandale at Kantang in Trang, on the west coast of peninsular Siam. It was caught running on the piers of the landing stage above water-level.

Sesarma edwardsi, de Man.

1888. *Sesarma edwardsi*, de Man, *Journ. Linn. Soc.*, XXII, p. 185, pl. xiii, figs. 1-4.
1917. *Sesarma* (*Sesarma*) *edwardsi*, Tesch, *Zool. Meded. Mus. Leiden*, III, p. 147.

Two males and one female, the largest with carapace 15½ mm. in breadth, were found in the Patani River in the Siamese Malay States. The specimens were obtained in fresh water, but in a locality subject to tidal influence.

Sesarma intermedium (de Haan).

1865. *Sesarma intermedia*, Heller, *Reise 'Novara', Crust.*, p. 64.
1918. *Sesarma* (*Sesarma*) *intermedium*, Tesch, *Zool. Meded. Mus. Leiden*, III, pp. 162, 243.

Two males from Shanghai are referred to this species. The carapace of the larger is 27 mm. in length and 31 mm. in greatest breadth; that of the smaller is 17·5 mm. in length and 20·8 mm. in breadth. In both specimens there is a single well marked tooth on the lateral margin behind the extra-orbital angle, but further back there is scarcely a trace of a rudimentary third lateral tooth, such as has been described in certain *Sesarma* referred to this species.

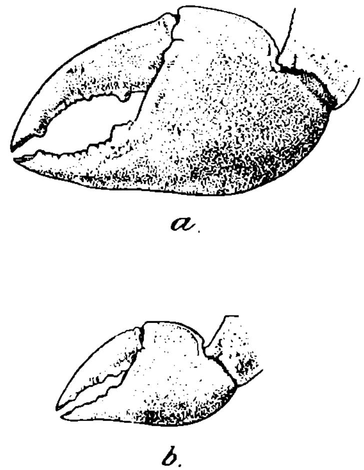

FIG. 2.—*Sesarma intermedium* (de Haan).
a. Left chela of a specimen 27 mm. in length.
b. Left chela of a specimen 17·5 mm. in length.

The crest on the upper margin of the merus of the chelipedes does not possess a subterminal tooth, as in *S. tetragonum*; the upper surface of the carpus is smooth and its inner margin bears a few small tubercles, but is not toothed. The upper margin of the palm is defined by an obscure and feebly crenulate ridge; its outer surface shows only the slightest traces of rugosity, but bears the oblique longitudinal line referred to by Tesch. The fingers are smooth except for a slight tuberculation on the dorsal surface of the dactylus near its proximal end. In both specimens the fingers gape, meeting only at the tips, the extent of the gape being very much greater in the larger specimen.

[1] De Man, *Zool. Jahrb., Syst.*, IX, p. 214 (1895), and X, pl. xxxi, fig. 30.

The walking legs are comparatively slender. The merus in the first pair is about two and a half times as long as broad in the larger specimen, about two and a quarter times in the smaller.

In certain respects the two specimens obtained by Dr. Annandale do not entirely agree with the descriptions given by de Man. In the notes published in 1880 he mentions the existence of traces of a third tooth on the lateral margins of the carapace and remarks that the ambulatory legs agree with those of *S. tetragonum*, in which species the merus is greatly expanded, that of the first pair being only twice as long as broad. In 1887 he compared the species with the closely allied *S. sinensis*, Milne-Edwards, distinguishing the latter by the proportionately longer fingers of the chela and more slender meropodites of the walking legs.

Dr. Annandale's specimens seem to some extent intermediate in character between *S. intermedium* and *S. sinensis* as understood by de Man. In the comparative slenderness of the walking legs they incline to *S. sinensis*, in which the merus of the first pair is described as being three times as long as broad (de Man, *loc. cit.*, 1887, p. 670), while in the proportionate length of the fingers of the chelipedes they appear to agree with *S. intermedium*. Outlines of the chelae of the two specimens are shown in text-figs. 2 *a*, *b*. The examples agree very closely with de Haan's original figure, in which the meropodites of the legs do not appear to be much expanded, and I have little doubt that my identification is correct.

The specimens recorded by de Man in 1888 from Mergui as *S. intermedia*[1] are unquestionably distinct; de Man has redescribed them under the name *S. moeschii*.[2]

The larger of the two specimens was obtained by Dr. Arthur Stanley from a creek near Shanghai, the smaller was found dead in a burrow on the banks of the Whangpoo River in the same neighbourhood. Both were from fresh water. The habits of the species appear to resemble those of *S. dehaani* (*infra*).

The species has been recorded from Japan, the Liu-Kiu Is., Shanghai and Hongkong. De Haan's supplementary record from Sourabaya in Java requires confirmation.

Sesarma dehaani, Milne-Edwards.

1917. *Sesarma (Holometopus) dehaani*, Tesch, *Zool. Meded. Mus. Leiden*, III, pp. 143, 238 (*ubi lit.*).

? 1917. *Sesarma (Holometopus) neglecta*, Tesch, *ibid.*, pp. 178, 238.

Examination of a limited number of specimens from both China and Japan leads me to believe that de Man's *S. neglecta* is not specifically distinct from *S. dehaani*, though it is possible that the name should be retained in a subspecific sense. *S. neglecta* was described from Shanghai, and *S. dehaani* from Japan, and the differences between the two have recently been summarised by Tesch (*loc. cit.*, p. 145).

The material I have examined consists of a large and small male and two females of medium size from the Yodo R., near Osaka (Yoshida coll.), a large male from

[1] De Man, *Journ. Linn. Soc.*, XXII, p. 182 (1888).

[2] De Man, in Weber's *Zool. Ergebn. Reise Neiderland, Ost-Ind.*, II, p. 331, pl. xx, fig. 14 (1892).

Yokohama (Berlin Mus.), a large male from Shanghai (Haberer coll.) and three rather small females from the same locality (Annandale coll.).

The carapace in these specimens yields the following measurements (in mm.) :—

Locality.		Sex.	Breadth at extra-orbital angles.	Breadth at base of penultimate legs.	Length.
Yodo R., nr. Osaka	..	♂	31·8	33·3	30·5
,, ,,	..	♀	25·9	27·1	24·1
,, ,,	..	♀	21·9	22·0	20·2
,, ,,	..	♂	19·0	18·4	17·0
Yokohama ..	..	♂	32·6	33·7	31·0
Shanghai ..	..	♂	32·0	31·8	29·9
,, ..	..	♀	19·7	19·5	17·7
,, ..	..	♀	19·9	19·3	17·4
,, ..	..	♀	15·9	15·2	13·6

It will be seen that as regards the proportion between length and extra-orbital breadth there is scarcely any difference between Japanese and Chinese specimens; but in large males from Japan the breadth at the base of the penultimate legs is a trifle greater than that at the extra-orbital angles, whereas the reverse is found in the large male from Shanghai. The difference is an extremely small one.

In large Japanese specimens the front is much more deeply excavate in dorsal view than in the large male from Shanghai, but this character is variable in smaller specimens from both localities.

In the large male from Shanghai the outer surface of the palm is obscurely granulate in its lower half, the upper half being nearly smooth. In the large males from Japan it is coarsely tuberculate both above and below. The vertical row of large tubercles on the inner face of the palm in the latter specimens is represented in example from Shanghai by a number of much smaller tubercles not arranged in a definite row.

The collection seems to indicate that while Japanese and Chinese individuals of small or medium size are altogether indistinguishable, large males from the two countries exhibit certain small but possibly constant differences. The material at my disposal is not sufficient to indicate the range of normal variation in adults.

The specimens from Japan were presented by Dr. S. Yoshida ; they were obtained in fresh water in the R. Yodo, above Osaka, where they run about on the piers of landing stages and on embankments at the edge of the river.

In the neighbourhood of Shanghai Dr. Annandale found the species common, along with *S. intermedia*; though found in fresh water it apparently does not penetrate so far inland as the Tai Hu. The banks of all the small freshwater creeks at Shanghai and ponds in the same neighbourhood are full of its burrows and large numbers of crabs may be seen in warm weather running on the mud. In winter they stay inside the burrows, only appearing in exceptionally warm sunny weather. None were seen in December at places where they were stated by residents to be common in summer, but young specimens were obtained by digging in embankments near the Whangpoo River; probably the burrows of the adults were much deeper.

Sesarma taeniolatum, White.

1900. *Sesarma taeniolatum*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 419.

Numerous specimens, the largest an ovigerous female with carapace $34\frac{1}{2}$ mm. in breadth between the outer orbital angles, were obtained by Dr. Annandale in the outer part of the Tale Sap. The ovigerous female was dug from a large and not very deep burrow at the edge of a small freshwater stream near the point where it entered the lake on Koh Yaw. Others were taken on fishing stakes and the piers of a landing stage above the water-line.

It is probable that the female recorded from Singgora by Lanchester [1] under the name *Sesarma lafondi*, Jacq. and Lucas,[2] was in reality an example of this species.

Sesarma siamense, Rathbun.

1910. *Sesarma (Chiromantes) siamense*, Rathbun, *Danske Vid. Selsk. Skrift.* (7), *naturvid. og math.*, V, p. 328, text-figs. 11 *a-c*.

Five specimens are in the collection, the largest a full-grown male with carapace 10·2 mm. in length and 11·3 mm. in breadth at the outer orbital angles. The epibranchial tooth is bluntly rounded in all the specimens and behind it rudimentary traces of a second tooth are usually visible. The large male has six sharp spinules on the upper edge of the dactylus; in the females there are four, five or six. The striae on the upper surface of the palm bear a close resemblance to Miss Rathbun's figure, but the very short distal stria that runs backwards from the dactylar articulation is only visible in one female.

The specimens were found among the roots of dead palm trees at Kaw Deng near the mouth of the Tale Sap, on fishermen's stakes opposite Koh Yaw in the same neighbourhood and in the Patani River, south-east of the Tale Sap, in the Siamese Malay States. The water in the first two localities was brackish, its specific gravity varying from 1·004 to 1·0085 (corrected); in the Patani River it was quite fresh when the specimens were taken, though probably brackish under certain conditions of tide.

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[1] Lanchester, *Proc. Zool. Soc. London*, 1901, p. 550.
[2] *Vide* Tesch, *Zool. Meded. Mus. Leiden*, III, p. 164, pl. xv (1917).

S. siamense was described by Miss Rathbun from the eastern side of the Gulf of Siam, from Koh Kong, Koh Kut and Koh Chick.

Sesarma foxi, sp. nov.

I take this opportunity of describing a very interesting species of *Sesarma* obtained in 1914 by Mr. B. H. Buxton at a height of 2000 ft. on Gunong Raya, in Langkawi I., N. of Penang. Species of this typically estuarine genus have seldom been recorded from considerable altitudes, though a number have been taken on land some distance from the coast-line. The following list, so far as I am aware, comprises all species of the genus that have been recorded from definite heights above sea-level.

Sesarma maculata, de Man. Halmahera, 2000 ft.
"*Sesarma maculata*," Lanchester (? de Man). Bukit Besar, near Patani, Siamese Malay States, 2500 and 3500 ft.
Sesarma trapezoidea, Guérin. Halmahera, 2500 ft.
Sesarma thelxinöe, de Man. Andamans, 800 ft.
Sesarma sp. (*vide infra*, p. 240). Penang, 1200 ft.

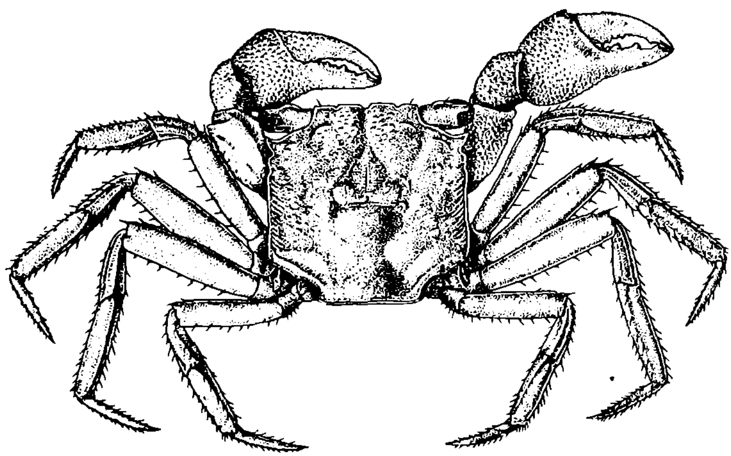

FIG. 3.—*Sesarma foxi*, sp. nov.

It appears probable that in these places the *Sesarma* have been able to adopt a strictly terrestrial mode of life and to ascend to considerable altitudes owing to the damp climate that prevails; in the Andamans the entire absence of competitors in the form of Potamonidae is doubtless an important factor.

The carapace in *S. foxi* is exactly quadrilateral, its length being precisely, or almost precisely, equal to its breadth; the lateral margins are strictly parallel, the breadth at the base of the third pair of legs being equal to that at the outer orbital angle. The carapace is slightly convex fore and aft and from side to side and is everywhere distinctly rugose and faintly pitted. A trifoliate gastric areola is distinct and behind it there is a slight prominence on the cardiac region; these areas are a little smoother than the rest of the carapace. The front is abruptly and vertically deflexed and is not visible in dorsal view. When viewed obliquely, the edge is seen to be produced to two broadly rounded lobes on either side of a median excavation. The four post-frontal lobes are sharp-edged and present a straight transverse line; those of the inner pair are broader than those of the outer and are separated by a deep mid-dorsal groove that extends to the anterior end of the gastric region. Behind the outermost post-frontal lobes on a level with the inner angle of the orbit there is a small but distinct elevation. The superior margin of the orbit is oblique and sinuous; the outer orbital tooth is sharp and rather broad, but does not extend so far outwards as the end of the cornea. There are two small epibranchial teeth, both obtuse and inconspicuous; the breadth between the foremost pair is a trifle less than that between the outer orbital angles. The lateral margin of the carapace is defined on either side by a sharp ridge, and the postero-lateral surface, though indistinctly rugose, bears no oblique striae, except for one, of considerable length, immediately over the bases of the last two pairs of legs.

The chelipedes much resemble those of *S. sylvicola*, de Man. The upper border of the merus ends in a subrectangular, subterminal lobe; the inner and outer margins are denticulate, the former being slightly produced near the distal end. The inner surface bears two longitudinal rows of hairs and the outer surface is furnished with a number of conspicuous granules. The upper surface of the carpus is strongly rugose; on its inner margin there are numerous denticles, but no outstanding tooth. The chela, in its general form, almost precisely resembles that of *S. sylvicola*. The palm is swollen and strongly tubercular externally, the tubercles being, however, confined to its proximal three-quarters, being absent in the neighbourhood of the finger-cleft, where there is a perfectly smooth, conspicuous depression (text-fig. 4). The tubercles are most closely packed on the upper border and from those which are scattered irregularly over the lower surface a single series, composed of four or five, extends on to the base of the fixed finger. The inner surface much resembles the outer, being similarly tuberculate and having a similar depression near the base of the fingers. It shows no distinct transverse row of tubercles. The fixed finger, except for the few tubercles at the proximal end of its lower margin, is smooth. The dactylus is nearly twice the length of the upper border of the palm; at its proximal end there are numerous small tubercles which extend in a single row a little beyond the middle of its length. In lateral view from six to eight tubercles are visible. There are occasional short, dark brown hairs on the carpus, palm, and at the base of the dactylus.

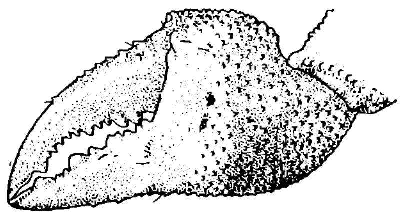

FIG. 4.—*Sesarma foxi*, sp. nov. External view of left chela of male.

The walking legs are exceptionally slender. The merus in each pair bears a prominent subterminal tooth on its anterior margin; the segment in the penultimate pair is little less than four times as long as broad. The dactylus in the first three pairs is about five-sixths the length of the propodus, that of the last pair is longer, almost equal to the length of the propodus. On all the legs there are conspicuous slender spinules, not very thickly set, on the carpus, propodus and dactylus; each spinule is dark brown basally and white distally.

The abdomen of the male is broad and closely resembles that of *S. sylvicola*.

In colour the carapace of the specimens is of a very dull reddish brown; the chelipedes are pale yellow suffused with pale red on the carpus and palm; the walking legs are deep brown with a fine mottling and dark chromatophores are thickly sprinkled on the abdomen.

The species is described from two males which yield the following measurements (in mm):—

Length of carapace	9·8	9·7
Breadth of carapace between outer orbital angles ..	9·8	9·8
Breadth of carapace at base of 3rd walking legs ..	9·8	9·8
Breadth of front..	5·0	5·0
Length of penultimate walking legs	22·0	21·5
Length of merus of penultimate walking legs ..	7·5	7·3
Breadth of merus of penultimate walking legs ..	2·0	1·9

The species differs from all the allied forms described by de Man in his Report on Max Weber's expedition to the Dutch East Indies in the shape of the carapace, which is not wider behind than in front; it is allied to *S. sylvicola*, from Sumatra, but in addition to the form of the carapace, differs in the tuberculation of the chelae, in the blunter epibranchial teeth and more slender merus of the walking legs. It is also closely related to *S. ocypoda*, Nobili[1], from Sumatra, from which it differs in the form of the carapace, in the number of denticles on the dactylus of the chela and in the proportions of the meropodites of the walking legs. Its nearest ally, however, is perhaps *S. aranea*, Nobili,[2] from Nias, in which the carapace is described as "perfettamente quadrato"; this species is smoother than *S. foxi*, the tuberculation on the outer face of the chela is obsolete inferiorly and the merus of the walking legs is less slender.

The specimens obtained by Mr. Buxton, the types of the species, were found on Gunong Raya in Langkawi I, at a height of 2000 ft. They were collected in moist places under stones or rotten wood at some distance from any stream. At Mr. Buxton's request I have named the species after Mr. Fox of Langkawi I.

The types of the species are in the Indian Museum, where they bear the number 9457/10.

Sesarma sp.?

I do not venture to name three small specimens of *Sesarma* obtained by Dr. Annandale on Penang Hill in the island of Penang at a height of 1200 ft. The specimens are all young; the carapace of the largest is only 7·5 mm. in length and its chelae do not appear to have assumed their adult form.

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[1] Nobili, *Ann. Mus. Civ. Genova* (2), XX, p. 513.

[2] Nobili, *ibid.*, p. 510.

Though the two forms are clearly allied there are many conspicuous differences between these young individuals and *S. foxi*. The carapace is decidedly broader than long and its lateral margins are posteriorly divergent. The orbital tooth is narrower, the first epibranchial tooth more prominent and a strong ridge runs obliquely inwards and backwards from the rudimentary second epibranchial tooth. The walking legs are much stouter, the merus of the penultimate pair being scarcely more than two and a half times as long as broad.

It is possible that these are young examples of the form described by Lanchester from "Lacom" and Bukit Besar as *Sesarma maculata*, de Man, but they differ noticeably from de Man's description, especially in the form of the penultimate segment of the male abdomen. It appears to me exceedingly improbable that the true *S. maculata*, which was described from Flores, can occur in the Malay Peninsula.

Sesarma politum, de Man.

1888. *Sesarma polita*, de Man, *Journ. Linn. Soc.*, XX, p. 189, pl. xiii, figs. 7-9.

Three specimens were found at the mouth of the Tale Sap on the shores of Kaw Deng. The largest is a female with carapace 21·5 mm. in length. In the smallest the carapace is only 7·5 mm. long and the second epibranchial tooth is undeveloped.

Genus **Helice**, de Haan.

Helice tridens, de Haan.

1894. *Helice tridens*, Ortmann, *Zool. Jahrb. Syst.*, VII, p. 727.

A single male, with carapace 26 mm. in breadth, was presented to Dr. Annandale by Prof. S. Yoshida. It was obtained in brackish water near Osaka in Japan.

Genus **Clistocoeloma**, A. Milne-Edwards.

Clistocoeloma merguiense, de Man.

1900. *Clistocoeloma merguiense*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 429.

Two specimens, a male and a female, were obtained by Dr. Annandale in fresh water near the mouth of the Patani River in the Siamese Malay States. The carapace of. the male is 8·3 mm. in length and 9·4 mm. in breadth; that of the female is 9·9 mm. in length and 11·8 mm. in breadth. The specimens were found in burrows in wet mud, under the trunk of a dead palm tree.

Family POTAMONIDAE.

In determining the ten species of river-crabs in the present collection I have followed the classification proposed by Alcock in 1910.[1] Alcock divides the family into two groups, the Potamoninae and the Gecarcinucinae, mainly on characters drawn from the structure of the mandibular palp. In the former subfamily the terminal segment of the palp is "simple, sometimes thickened at the base for the attachment of a bunch of hairs," whereas in the latter it is "cut into two lobes which em-

[1] Alcock, *Cat. Indian Decap. Crust.*, I, fasc. ii, p. 17 (1910).

brace the incisor-process of the mandible." Calman,[1] whose notes on the point will be read with much interest, has since shown that in certain crabs from Madagascar the form of the palp is in some degree intermediate in character, though it is still quite clear that the species in question belong to the Potamoninae. My own experience with Indo-pacific species tallies with that of Alcock : the distinction between the two groups is absolute and the structure of the palp can easily be made out without dissection.

Even if it should be shown in course of time that the two groups intergrade in certain countries, necessitating some nomenclatorial changes in Alcock's system, the character will none the less retain considerable systematic importance and there is no doubt that it will prove a very essential factor in all problems connected with the distribution of the family.

Alcock's classification is unfortunately attended by some inconvenience. Prior to 1910, the date when his memoir was published, the structure of the mandibular palp is never mentioned in specific descriptions, with the result that it is frequently impossible to refer a species to its correct genus without actual examination of specimens. A case in point has occurred among the species in the present collection. *Potamon (Geotelphusa) dehaani* (White) from Japan bears a very close external resemblance to the Javanese crab originally described as *Geotelphusa kuhli*, so much so that de Man, when instituting the latter species, compared it in detail with the former. The two species have, however, no real affinity; that from Japan is a true *Geotelphusa*, belonging to the Potamoninae, whereas the Javanese form is a *Paratelphusa*, belonging to the subfamily Gecarcinucinae and to Alcock's subgenus *Liotelphusa*.

It is to be hoped that in all future work on the Potamonidae note will be made of the structure of the mandibular palp.

Subfamily *POTAMONINAE*.

Genus **Potamon**, Savigny.

1910. *Potamon*, Alcock, *Cat. Indian Decap. Crust.*, I, fasc. ii, p. 18.

Subgenus **Potamon**, Ortmann.

Potamon (Potamon) denticulatum (Milne-Edwards).

1904. *Potamon (Potamon) denticulatus*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VI, p. 260, pl. ix, fig. 6.

Fourteen specimens of this species, the largest a female with carapace 40 mm. in breadth, were collected by Dr. Annandale in the Tai Hu, in the Kiangsu province of China. They were obtained from a Chinese fishing boat with examples of *Eriocheir sinensis* and were said to have been caught in a creek opening into the lake.

Potamon (Potamon) granulatum (de Man).

1904. *Potamon (Potamon) granulatus*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VI, p. 274.

An adult female and four young specimens, of which only one is a male, were obtained by the late Dr. W. C. Hossack in Java.

[1] Calman, *Proc. Zool. Soc. London*, 1913, pp. 922-925.

As in the case of the female recorded by Nobili,[1] the granulation of the carapace appears to be rather less pronounced than in the large male described by de Man,[2] though it is far more conspicuous than in any allied species. The extreme development shown in de Man's figures is doubtless to be found only in adult males.

As de Man has pointed out, the crest of the antero-lateral border is decidedly shorter than in related forms: in this respect a marked difference exists between *P. granulatum* and *P. andersonianum* (Wood-Mason). In the specimens in the present collection, however, the granules on this border are more numerous than is indicated by de Man; they are never less than ten in number and are very irregular in their size and distribution.

Potamon larnaudi (A. Milne-Edwards), as Miss Rathbun has shown, is readily distinguished by the greater breadth of the mesogastric area.

The specimens examined were found in the Government Quinine Gardens at Tijnproean at an altitude of 5600 ft. The carapace of the large female is 41 mm. in breadth and 32 mm. in length. The species has hitherto been recorded only from Tijibodas.

Potamon (Potamon) stoliczkanum (Wood-Mason).

1910. *Potamon (Potamon) stoliczkanum*, Alcock, *Cat. Ind. Decap. Crust.*, I, fasc. ii, p. 53.

Two small males were obtained by Dr. Annandale in the Botanical Gardens at Penang; they were found under stones in a rapid running stream.

There is apparently some variation in the form of the epigastric and post-orbital crests. Those of the larger example do not form an absolutely transverse line, but are a trifle more advanced in the middle than at the sides. In the smaller individual the line formed by the crests is more nearly transverse, almost as much so as in the types.

In the larger individual the carapace is 21 mm. in length and 26 mm. in breadth, the length of the second walking leg being nearly 47 mm.

P. stoliczkanum has only been recorded from Penang (Wood-Mason) and "Lacom" (Lanchester). The specimens recorded by de Man from Mergui, under the name *Telphusa stoliczkana*, have been referred to *P. thagatense*, Rathbun.

Potamon (Potamon) anacoluthon, sp. nov.

The carapace is longer than in most species of the genus, the breadth being only about one and one fifth times the length. The upper surface is slightly convex fore and aft and from side to side. The usual H-shaped groove is conspicuous, but otherwise the carapace is almost wholly without distinction of regions. The middle portion of the cervical groove is indicated by a broad and very shallow depression and between this depression and the antero-lateral limits of the H-shaped groove there is, in both the specimens examined, a small flattened tubercle standing in the middle of a shallow pit. The entire surface, though it has a shiny appearance when dried, is coarsely and evenly punctate, the punctae being sometimes connected by exceedingly

[1] Nobili, *Ann. Mus. Civ. Genova* (2), XX, p. 500 (1900).

[2] De Man, in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 290, pl. xvi, fig. 5 (1892).

fine grooves, to be seen only under a strong lens. The epigastric crests are prominent; their anterior edges are strongly and irregularly rugose and they are separated in the middle by a deep grove which, however, does not extend backwards behind them. The protogastric or post-orbital crests are practically obsolete, being represented merely by a slight roughened declivity separated by a faint transverse depression from the upper orbital margin. Internally the crests are on a line with, and only indistinctly separated from, those on the epigastric region; from this point they slope backwards on either side, completely disappearing before reaching the lateral margin. The upper border of the orbit is practically smooth; the lower margin is beaded and there is a distinct sinus beneath the outer orbital angle. The front is faintly emarginate in the middle and its breadth is contained about two and two-thirds times in that of the carapace. The edge is very finely crenulate and the upper

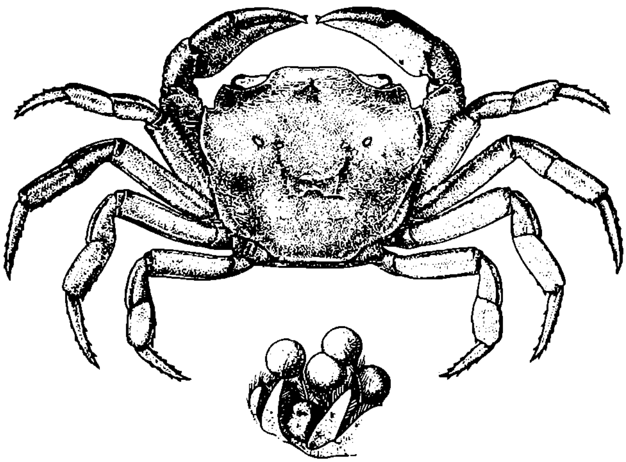

FIG. 5.—*Potamon* (*Potamon*) *anacoluthon*, sp. nov.
Male, 17·8 mm. in breadth of carapace, and eggs of female drawn to same scale.

surface finely rugose. The epibranchial tooth is very strong and is situated at some distance from the outer orbital angle; the surface in its vicinity is distinctly roughened. The level of the carapace in front of the epibranchial tooth is the same as that behind it. The margin between the tooth and the outer orbital angle is beaded; behind the tooth it is finely denticulate. The postero-lateral walls bear a few fine oblique striae; the lower surface, on either side of the buccal cavern, is covered with short rugae from which small setae arise.

The ischium of the outer maxillipedes is traversed longitudinally in its middle by a fine and deep groove; it bears very large punctae, especially near the antero-internal angle. The merus is much broader than long, with raised outer and inner borders and with its antero-external angle rounded off. The basal portion of the exopod reaches to the middle of the merus; the flagellum is very long.

The chelipedes of the male are scarcely longer than the breadth of the carapace. The upper edge of the merus is granular and terminates in a blunt and obscure subterminal lobe. Both inferior margins are granular and the outer surface bears numbers of small rugae arranged transversely. The carpus is rugose above; the internal tooth is very strong and behind and beneath its apex there are one or two conspicuous tubercles. The chela is slender, the depth of the palm being only about one and a half times the length of the upper border. The outer surface is slightly rugose proximally and bears numerous punctae, some of which form a conspicuous, median, longitudinal row. The fingers are nearly twice the length of the upper border of the palm; they are strongly fluted and pitted and meet throughout their length when the claw is closed, the tips crossing each other.

The second walking legs, which are the longest, are about one and three quarters the length of the carapace.

The abdomen of the male is very broad and is irregularly pitted. The segments increase successively in length, that of the sixth being only one third its basal breadth; the seventh segment is simply triangular, with a slightly sinuous proximal border, and its length is contained about one and three quarter times in its basal breadth. In the female the last abdominal segment is still more broadly triangular, its length being scarcely more than one half its basal breadth. The eggs are extremely large, each being from 2·0 to 2·5 mm. in diameter (text-fig. 5).

The species is described from two specimens, a male and a female, the latter ovigerous, but lacking the chelae. In the male the carapace is 14·6 mm. in length and 17·8 mm. in breadth; in the female it is 17·3 mm. in length and 19·9 mm. in breadth. The female in life was dull olive brown with bright red eggs; the male was of a distinctly blue shade of grey, a colour that has not apparently altered after nine months' preservation in spirit.

P. anacoluthon appears in some measure to form a link between the subgenera *Potamon* and *Geotelphusa*, agreeing with the former in the presence of a strong epibranchial tooth and with the latter in the almost complete suppression of the postorbital crests. It does not seem to possess close affinities with any species hitherto described.

The two specimens, types of the species, were found by Dr. Annandale on the Peak at Hongkong, under large stones at the edge of a small stream at an altitude of 1000 ft. They are preserved in the Indian Museum and bear the number 9475/10.

Potamon (Geotelphusa) dehaani (White).

1905. *Potamon (Potamonautes*[1]*) dehaanii*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VII, p. 204, pl. xviii, fig. 4.

1907. *Geothelphusa Dehaani*, Stimpson, *Smiths. Misc. Coll.*, XLIX, p. 112 (*nec. syn.*).

1916. *Potamon (Geothelphusa) Dehaanii*, Parisi, *Atti Soc. Ital. Sci. Nat.*, LV, p. 163.

The collection contains numerous specimens from Japan. The species was common in hill streams, in ponds and in irrigation channels in the country round Lake

[1] Presumably a clerical error for *Geothelphusa*, but repeated in a footnote under Stimpson's record.

Biwa. It is said to enter the lake itself, but Dr. Annandale could find no specimens there. In wet weather it often travels a considerable distance from water and one individual was found in the streets of Otsu. The precise localities of the specimens are (i) from hill streams and garden paths near Otsu; (ii) from irrigation channels at Hikone on the western shore of L. Biwa; (iii) from hill streams above Sakamoto on the eastern shore of L. Biwa; (iv) from a small lake at Komatsu on the same shore of the lake.

In the largest male, a specimen with carapace 30 mm. in breadth, the right chela is enormously enlarged, 31·5 mm. in length, with very widely gaping fingers.

Subfamily *GECARCINUCINAE*.

Genus **Paratelphusa**, Milne-Edwards.

1910. *Paratelphusa*, Alcock, *Cat. Indian Decap. Crust.*, I, fasc. ii, p. 70.

Subgenus **Paratelphusa**, Wood-Mason.

Paratelphusa (Paratelphusa) tridentata, Milne-Edwards.

1905. *Potamon (Paratelphusa) tridentatus*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VII, p. 234, pl. xi, fig. 2.

A number of distinct species were at one time confounded under this name: the series so labelled in the Indian Museum collection contains, in addition to the true *P. tridentata*, examples of *P. convexa*, de Man, *P. maculata*, de Man and *P. oxygona*, Nobili. In determining this material I have derived much assistance from de Man's papers, particularly that published in 1879,[1] as well as from Miss Rathbun's key and full references to the literature.

The specimens of *P. tridentata* in the present collection are five in number, all collected by the late Dr. W. C. Hossack in Java. There are three males and a female from Buitenzorg Gardens, alt. 300 ft., and one female from Garoet, alt. 3000 ft. The carapace of the largest individual, a female, is 42 mm. in breadth.

The species is recorded from Borneo, Java, Sumatra and the neighbouring islands.

Paratelphusa (Paratelphusa) convexa, de Man.

1905. *Potamon (Paratelphusa) convexus*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VII, p. 237.

Three specimens were obtained by Dr. Hossack in Java in company with examples of the preceding species. A male and female with carapace respectively 27 and 28·5 mm. in breadth were found in Buitenzorg Gardens and a female of similar size at Garoet. The specimen from the latter locality differs from the others in colour, being rather closely mottled with deep purple on a dull olive ground.

P. convexa is known from Timor, New Guinea, Borneo, Java and Nias.

[1] De Man, *Notes Roy. Zool. Mus. Leyden*, I, p. 61 (1879).

Paratelphusa (Paratelphusa) incerta (Lanchester).

1905. *Potamon (Paratelphusa) incertus*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VII, p. 238 (*ubi syn.*).

Of this species Dr. Annandale obtained a single fine male, with carapace 55 mm. in breadth, in the Botanical Gardens at Singapore. It was found on a wet day in a rubber plantation, sitting at the edge of a burrow in the bank of an irrigation channel.

Paratelphusa incerta is very closely related to the Sumatran *P. maculata*, de Man; but, so far as I am able to judge from the examination of a single specimen, is not merely a variety of that species as suggested by Nobili.[1] Compared with a series of *P. maculata* from Deli in Sumatra, the following differences are apparent:—

(i). The carapace is broader and shorter: measured in the middle line the distance from the edge of the front to the cervical suture is conspicuously less than half the greatest breadth of the carapace. In *P. maculata* these two measurements are exactly the same.

(ii). An imaginary line joining the tips of the posterior epibranchial teeth is situated rather further forwards than in *P. maculata*.

(iii). The lateral extremities of the post-orbital crests reach a point only a little in front of the middle of the foremost epibranchial tooth and are thus situated further backwards than in the allied form.

(iv). The external orbital angle is rather more obtuse and the two epibranchial teeth project outwards more strongly. The distance between the extra-orbital angle and the first lateral tooth is only a little greater than that between the first and second lateral teeth.

P. incerta is known only from Singapore and was originally described by Lanchester from a specimen found in the Botanical Gardens. The individual recorded by Lanchester from Borneo[2] has been referred by Miss Rathbun[3] to Nobili's *P. oxygona*.

Paratelphusa (Paratelphusa) germaini (Rathbun).

1901. *Potamon (Paratelphusa) sinense*, Lanchester, *Proc. Zool. Soc. London*, p. 545.

1905. *Potamon (Paratelphusa) germaini*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VII, p. 246, (*ubi cet. syn.*), pl. xi, fig. 9.

1906. *Potamon (Paratelphusa) sex-punctatum*, Lanchester, *Fasciculi Malayenses, Zool.*, III, p. 129, fig. 2.

Dr. Annandale found this species in abundance in ditches and ponds and at the edge of the Tale Sap at Lampam, where the water of the lake is quite fresh. It was common also at Singgora, but apparently does not enter the brackish outer portions of the lake though it occurs in ditches containing water that is slightly saline. It was also common in ditches at Patani and in pools on the sand near the sea.

In a very old male, much overgrown with alga, the carapace is 56 mm. in breadth

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[1] Nobili, *Boll. Mus. Zool. Torino*, XVI, no. 397, p. 8 (1901).

[2] Lanchester, *Ann. Mag. Nat. Hist.* (7), VI, p. 255, pl. xii, fig. 2 (1900).

[3] Rathbun, *loc. cit.*, p. 239.

and 44 mm. in length; the chela is 64 mm. in length with very widely gaping fingers. Adults are invariably of a rich reddish crimson colour, stains of which not infrequently occur on the sternum. The six punctae described by Lanchester in his account of *P. sexdentatum* are visible in most of the specimens and four of them are often rendered conspicuous by their colouration, which is pale yellow and contrasts sharply with that of the general surface. Young individuals are of a dull olive brown tint.

There can be little doubt that the synonymy given above is correct. *P. germaini* is recorded by Miss Rathbun from many localities in French Indo-China and Siam and also from the islands off the west coast of the Malay Peninsula and (doubtfully perhaps) from Japan. It is evidently the common river crab of the country round the Tale Sap, from which it was recorded by Lanchester under the name *Potamon* (*Paratelphusa*) *sinense*.

Subgenus **Liotelphusa**, Alcock.

1910. *Liotelphusa*, Alcock, *Cat. Indian Decap. Crust.*, I, fasc. ii, p. 109.

Paratelphusa (Liotelphusa) kuhli (de Man).

1883. *Geothelphusa Kuhlii*, de Man, *Notes Leyden Mus.*, V, p. 154.
1892. *Geotelphusa Kuhlii*, de Man, in Weber's *Zool. Ergebn Reise. Nied. Ost-Ind.*, II, p. 288, pl. xv, figs. 3*a-c*, pl. xvi, fig. 3.
1905. *Potamon* (*Geothelphusa*) *kuhlii*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VII, p. 208.

Other references are supplied by Miss Rathbun. Hitherto the species has invariably been referred to *Geotelphusa*; in general appearance it bears a very close resemblance to *Potamon* (*Geotelphusa*) *dehaani* (White), and it has been compared in detail with that species by de Man. Examination of the mandibular palp shows, however, that in spite their external similarity there is no close affinity between the two forms. In *P.* (*G.*) *dehaani* the terminal segment of the palp is simple, the species belonging to Alcock's subfamily Potamoninae. In "*Geotelphusa*" *kuhli* the terminal segment is formed of two lobes which embrace the incisor-process of the mandible; the species will therefore find a place in the subfamily Gecarcinucinae of Alcock's classification and must be referred to the genus *Paratelphusa* and the subgenus *Liotelphusa*. It is by no means distantly related to *P.* (*L.*) *levis* (Wood-Mason).

Paratelphusa kuhli is represented in the collection by a series of more than thirty specimens of all ages. In her key to the species of the subgenus *Geotelphusa*, Miss Rathbun lays stress on the presence in this species of a rudimentary epibranchial tooth. The use of this character is, however, likely to prove misleading, for the tooth is entirely absent in a number of the specimens in the present collection, while in all the others only the faintest traces of its presence can be detected.

The specimens were found by the late Dr. W. C. Hossack in the Government Quinine Gardens at Tijnproean in Java at an altitude of 5600 ft. The species is only known from Java.

Family XANTHIDAE.

Subfamily *MENIPPINAE*.

Genus **Myomenippe**, Hilgendorf.

Myomenippe granulosa (A. Milne-Edwards).

1898. *Menippe* (*Myomenippe*) *granulosa*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVII, p. 179.

Two small specimens, the largest with carapace 18·5 mm. in breadth, were found at the mouth of the Prai River, opposite Penang, on mud flats left bare at low tide.

Subfamily *PILUMNINAE*.

Genus **Pilumnus**, Leach.

Pilumnus quadridentatus, de Man.

1888. *Pilumnus seminudus*, de Man, *Journ. Linn. Soc.*, XXII, p. 65.
1895. *Pilumnus* (*Parapilumnus*) *quadridentatus*, de Man, *Zool. Jahrb. Syst.*, VIII, p. 537 and IX, pl. xiii, fig. 6.
1906. *Pilumnus quadridentatus*, Nobili, *Ann. Sci. nat., Zool.* (9), IV, p. 278.

A male and an ovigerous female, 9·3 mm. and 8·8 mm. in breadth respectively, were found in dead shells of *Balanus* on fishing stakes in the channel off Singgora at the mouth of the Tale Sap. A very young individual, with carapace only 5 mm. in breadth, was also found among mangrove roots near Koh Yaw.

In addition to the long hairs on the upper surface of the front and to those which extend inwards in a curved line from the last tooth of the antero-lateral margin, there are two conspicuous setose areas on the gastric region. These are situated further forwards than in de Man's figure and each is oval in outline and is produced externally forwards and outwards towards the middle of the orbital margin (text-fig. 6). In a specimen from Mergui, one of those identified by de Man in 1888 as *P. seminudus*, Miers, I can find no trace of these patches; but they are easily removed in cleaning the carapace and leave practically no trace of their existence.

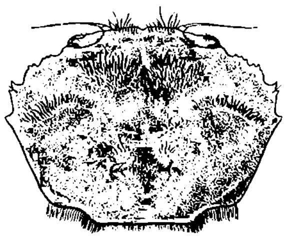

FIG. 6.—*Pilumnus quadridentatus*, de Man. Carapace.

The granulation of the outer surface of the palms of the chelipedes is conspicuous in all the specimens, the larger granules being arranged in longitudinal rows. De Man notes that in very large males the granules almost completely disappear.

In all other respects the specimens agree very closely with de Man's detailed description. The species is evidently closely allied to *P. malardi*, de Man,[1] a form also found in dead *Balanus* shells, but differs in the shape of the front and the form of the teeth on the antero-lateral margin.

[1] De Man, *Bull. Soc. Zool. France*, XXXIX, p. 330 (1914)

Family PORTUNIDAE.

Subfamily *PORTUNINAE*.

Genus **Scylla**, de Haan.

Scylla serrata (Forskål), de Haan.

1899. *Scylla serrata*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVIII, p. 27.

This species is the common edible crab of the Malay Peninsula. Dr. Annandale found it abundant in the outer part of the Tale Sap and young specimens were observed in ditches of brackish water and in mangrove swamps.

Genus **Neptunus**, de Haan.

Neptunus pelagicus (Linn.).

1899. *Neptunus pelagicus*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVIII, p. 34.

Very abundant in the outer part of the Tale Sap. Young specimens were taken in the channel opposite Singgora and round Koh Yaw in from 3 to 4½ metres, usually among dead shells.

Genus **Charybdis**, de Haan.

Charybdis crucifera (A. Milne-Edwards).

1899. *Charybdis* (*Goniosoma*) *crucifera*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVIII, p. 51.

Common at Singgora. Many dead specimens were seen at the edge of the lake.

Charybdis affinis, Dana.

1899. *Charybdis* (*Goniosoma*) *affinis*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVIII, p. 56.

Two large specimens, with carapace 67 mm. and 51 mm. in breadth, are in the collection. They are considerably larger than any other examples in the Museum and differ from Alcock's description in the almost complete absence of the transverse ridge on the cardiac region of the carapace. This character, which is used by Alcock in his key to the Indian species of the genus, is evidently not valid in the case of very large specimens.

The specimens were taken in fishing nets at Singgora.

Charybdis callianassa (Herbst), A. Milne-Edwards.

1899. *Charybdis* (*Goniosoma*) *callianassa*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVIII, p. 57.

Found with the preceding at Singgora.

Tribe **OXYSTOMATA**.

Family LEUCOSIIDAE.

Subfamily *LEUCOSIINAE*.

Genus **Ebalia**, Leach.

Ebalia heterochalaza, sp. nov.

The carapace is sharply polygonal in outline and is broader than long in the proportion of 14 to 13. The lateral and posterior margins are coarsely granulate and the postero-lateral border is divided into thirds by two clusters of enlarged and prominent tubercles (text-fig. 7). The grooves and depressed portions of the carapace are smooth and the elevated parts tubercular. The sculpture of the dorsum is much as in *E. diadumena*, Alcock, but the grooves are not so deep. The elevations on the gastro-cardiac, intestinal and branchial regions are coarsely granulate and in the middle of the two former are several very large upstanding tubercles of a pearly appearance and of a size much greater than those on any other part of the carapace. The gastro-cardiac and intestinal elevations are imperfectly separated from one another by a transverse furrow; the granules on them are very dissimilar in size. The front is deeply hollowed in the middle line; its antero-lateral portions bear numerous fine denticles. The anterior margin is practically straight, the edge of the epistome being visible in dorsal view. The hepatic facet is well defined; its lower border is excavate posteriorly and is edged with exceptionally large tubercles. Its upper margin is defined by smaller tubercles which form a cluster near the middle of its length. The posterior limit of the facet is marked on either side by a large tubercle and the margins between these tubercles and those that define the widest portion of the carapace are straight and posteriorly divergent. The posterior margin is narrow, slightly sinuous, a little prominent at the middle point and with protruding lateral angles. The lower surface of the carapace, on either side of the outer maxillipedes, is conspicuously granular.

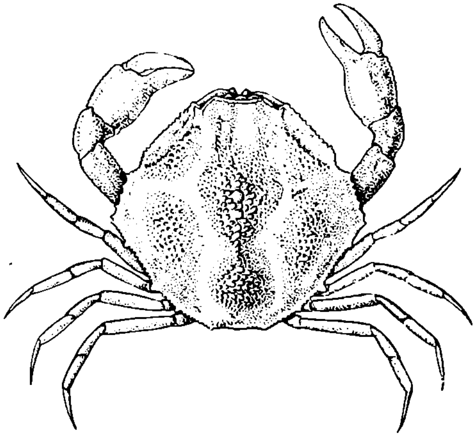

FIG. 7.—*Ebalia heterochalaza*, sp. nov.

The cornea of the eye is scarcely visible in dorsal view; the orbits are in open communication with the antennular fossae. The margin of the epistome bears two sharp processes separated by a median emargination.

The endopod of the outer maxillipedes is very narrow; the merus is almost exactly the same length as the inner border of the ischium. The exopod is only a trifle shorter than the endopod and has a strong outward bulge; it is conspicuously granular and its outer margin is very strongly curved.

The chelipedes in the male are scarcely longer than the carapace. The merus is trigonal with granular edges; it is covered with minute granules on its lower side and with a few near the base of its upper surface. There are minute granules on the carpus. The upper edge of the palm is roughened and on its lower surface are two finely beaded lines that extend from its base to the tip of the fixed finger. The uppermost of these lines is better defined than the lower and the space between them is smooth. The fingers are heavy and meet only in the distal half of their lengths, where they are provided with teeth; both fingers are obscurely grooved and there are minute asperities on the upper surface of the dactylus.

The walking legs are smooth and slender; in those of the last pair the dactylus is fully one and a half times the length of the propodus.

The sternum of the male is granular throughout, the granules being very large and vesiculous opposite the bases of the chelipedes. The abdomen of the male consists of four pieces, a transverse basal portion, perhaps partially fused with that which follows, and three distal pieces, the two last being each about half the length of that which precedes them. The basal breadth of the penultimate portion is scarcely less than half its length; there is no median tubercle. The middle parts of all except the ultimate portion are closely covered with minute granules.

The species is described from two males with carapace respectively 5·2 and 4·6 mm. in length.

Ebalia heterochalaza appears to be nearly allied to *E. granulata* (Rüppell), redescribed by Nobili in 1906,[1] the latter form differs, however, in the granulation of the carapace; the front and orbital margins are smooth and there are enlarged granules on the branchial regions similar in size to those in the middle line. The front in *E. granulata* is also conspicuously bilobed, there are no granules on the third maxillipedes or on the sternum and there is a large tubercle on the penultimate segment of the male abdomen. The last character affords a distinction between *E. heterochalaza* and *E. abdominalis*,[2] in which also the chelipedes are much longer and do not possess longitudinal granular ridges on the lower surface of the palm. From *E. diadumena*, Alcock,[3] it differs conspicuously in the shallower sculpture of the carapace and in the presence of a well-defined hepatic facet.

The specimens were found at a depth of about 4½ metres, on a bottom composed of soft mud with many dead shells, just inside the mouth of the Tale Sap, near Singgora. They were obtained in water of low salinity, its specific gravity being about 1·004 (corrected).

The two specimens, types of the species, are registered under no. 9426/10 in the Indian Museum books.

Genus **Philyra**, Leach.

Philyra sexangula, Alcock.

1896. *Philyra sexangula*, Alcock, *Journ. Asiat. Soc. Bengal*, LXV, p. 241, pl. vii, fig. 2 and (1899) *Illust. Zool. 'Investigator' Crust.*, pl. xxix, figs. 6, 6*a*.

1900. *Philyra sexangula*, Lanchester, *Proc. Zool. Soc. London*, p. 765.

A very small male, with carapace only 3·2 mm. in length, was obtained by Dr. Annandale. The sculpture in this individual is more clean-cut than in the larger specimens recorded by Alcock. The outline of the carapace is much more sharply angular,

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[1] Nobili, *Ann. Sci. nat*, *Zool.* (9), IV, p. 155, pl. ix, fig. 1 (1906).

[2] Nobili, *ibid.*, p. 157, pl. ix, fig. 2 (1906).

[3] Alcock, *Journ. Asiat. Soc. Bengal*, LXV, p. 187, pl. vii, fig. 4 (1896).

the oblique carinae on the branchial regions are exceedingly strong and in the middle line are five large blunt tubercles of which only traces remain in adults. The chelipedes have the same proportional length as in older examples, but are practically devoid of granules.

The specimen was found in the same locality as *Ebalia heterochalaza*, in water of specific gravity 1·004.

The species was hitherto known from the Godaveri Coast and Persian Gulf (Alcock), from the Matlah river in the Gangetic Delta, whence a large female, 9·5 mm. in length, was obtained a few years ago by Dr. J. T. Jenkins, and from Singapore (Lanchester).

Philyra olivacea, Rathbun.

1909. *Philyra olivacea*, Rathbun, *Proc. Biol. Soc. Washington*, XXII, p. 108.

1910. *Philyra olivacea*, Rathbun, *Danske Vid. Selsk. Skrift.* (7), *nat. og math.*, V, p. 312, pl. ii, fig. 17, and text-fig. 4.

Two specimens, both males, are in the collection; in most respects they agree well with Miss Rathbun's description. The posterior margin of the carapace, described as trilobate in the original examples, is merely sinuous with the outer angles prominent. The two oblique lines which run inwards from the postero-lateral margins and converge are exceedingly obscure, though visible in both specimens; they consist merely of a single row of low and widely spaced granules and might easily be overlooked.

There is a considerable difference between the two specimens in the form of the angulation of the lower margin of the hepatic facet. In the smaller specimen it is much the more prominent and is quite pale in colour, the remainder of the carapace being a very dark grey. The larger individual is pale in colour throughout.

The specimens are respectively 9·5 and 8·0 mm. in length. One was taken along with the examples of the two preceding species near Singgora, in water of specific gravity 1·004; the other was found in the bottom of a fishing boat at Patani, far to the south of the Tale Sap, and had probably come from Patani Bay.

The species was previously known only from the Coast of Lem Ngob on the eastern side of the Gulf of Siam.

Family DORIPPIDAE.

Genus **Dorippe,** Fabricius.

Dorippe astuta, Fabricius.

1896. *Dorippe astuta*, Alcock, *Journ. Asiat. Soc. Bengal*, LXV, p. 280.

A specimen with carapace about 11 mm. in length was found dead near the mouth of the Tale Sap and two smaller individuals were taken in the channel opposite Singgora in water of specific gravity 1·004 (corrected). They were found on a bottom of mud and dead shells at a depth of 4½ metres and neither of them carried anything in the last pair of legs. Alcock states on the authority of Giles that it is the custom of this species to carry an inhabited worm-tube.

Tribe **PAGURIDEA.**

Family PAGURIDAE.

Subfamily *PAGURINAE.*

Genus **Clibanarius,** Dana.

Clibanarius padavensis, de Man.

1888. *Clibanarius padavensis*, de Man, *Journ. Linn. Soc.*, XXII, p. 242, pl. xvi, fig. 1.

Three specimens were found by Dr. Annandale at the mouth of the Prai River, opposite Penang, on mud-flats exposed at low water. They were living in *Murex* and other marine shells.

Clibanarius longitarsis (de Haan).

1887. *Clibanarius longitarsis*, de Man, *Arch. f. Naturgesch.*, LII, i, p. 441.

This species was very abundant at Kaw Deng and in other localities near the mouth of the Tale Sap. All the larger individuals were inhabiting marine shells, but very small ones were usually found in *Potamides fluviatilis*. Dr. Annandale noted that the legs in living specimens were very deep blue with bright blue longitudinal stripes and that the eyestalks were bright olivaceous brown.

Genus **Diogenes,** Dana.

Diogenes avarus, Heller.

1905. *Diogenes avarus*, Alcock, *Cat. Indian Decap. Crust.*, II, fasc. i, p. 68, pl. vi, fig. 6.

Two very small specimens, dredged in the outer part of the Tale Sap, opposite Singgora, appear to belong to this species.

Tribe **THALASSINIDEA.**

Family CALLIANASSIDAE.

Subfamily *UPOGEBIINAE.*

Genus **Upogebia,** Leach.

Upogebia (Upogebia) heterocheir, Kemp.

1915. *Upogebia (Upogebia) heterocheir*, Kemp, *Mem. Ind. Mus.*, V, p. 257, pl. xiii, figs. 6, 7.

Two specimens were dredged towards the northern part of the channel connecting the inner and outer parts of the Tale Sap near Pak Payum at depths of 3½ to 5½ metres. They were taken in a thin layer of soft mud overlying a bottom of coarse sand in water of specific gravity 1·0015 (corrected).

One of the specimens is very much damaged; the other is a male approximately 16 mm. in total length. In this specimen the first peraeopods differ from those of the types in the absence of the subterminal tooth on the upper edge of the merus and in the presence of only one tooth on the upper border of the propodus. The extent of the variation in the number of spinules on the legs is thus rather greater than was gathered from examination of the Indian specimens.

The species has hitherto been found only in the Chilka Lake on the Orissa coast of India, where it was obtained in water ranging in specific gravity from 1·000 to 1·0265.

DECAPODA NATANTIA.

Tribe CARIDEA.

Family PALAEMONIDAE.

Genus **Palaemon**, Fabricius.

Palaemon carcinus, Fabricius.

1890. *Palaemon carcinus*, Ortmann, *Zool. Jahrb., Syst.*, V, p. 700, pl. xlvii, fig. 1.
1902. *Palaemon (Eupalaemon) carcinus*, de Man, *Abhandl. Senck. naturf. Ges.*, XXV, p. 763.
1910. *Palaemon carcinus*, Henderson and Matthai, *Rec. Ind. Mus.*, V, p. 281, pl. xv, figs. 1 *a-g*.
1914. *Palaemon carcinus*, Cowles, *Philippine Journ. Sci.*, Sect. D, IX, p. 324, pl. i, figs. 1, 1*a-j*.

The collection contains numerous specimens of this well-known species from the Malay Peninsula. Three males, which doubtless came from the Patalung river where the water is always fresh, were bought in the market at Lampam and a large number of specimens were obtained from fishermen's nets at Singgora in the Tale Sap in water of specific gravity varying from 1·004 to 1·0085.

It is a remarkable fact that all the Singgora specimens, with one exception, are females and that nearly all of them bear eggs. In our investigations on the fauna of the Chilka Lake on the Orissa coast of India, we drew attention to the fact that certain species of *Palaemon, P. rudis* and *P. malcolmsoni*, visit the lake each year at the period when its waters are at their freshest in order to liberate their young. In the case of *P. malcolmsoni* this migration is undertaken only by the ovigerous females, whereas in *P. rudis* the males accompany the females.[1]

It appears that a similar phenomenon occurs in the Tale Sap in the case of *P. carcinus*. Dr. Annandale found only a single male and very few females without eggs out of many hundreds of specimens examined at Singgora and there can be little doubt that the females migrate to the lake for breeding purposes. The specimens were obtained in January at the beginning of the dry season when the water of the outer part of the lake was probably fresher than at other times.

The specimens agree well with the published descriptions. The rostrum as a rule extends much beyond the antennal scale, but in one male from Lampam, 168 mm. in total length, reaches beyond this point only by some 5 mm. There are from 12 to 15 teeth on the upper border of the rostrum and from 10 to 14 (usually 12 to 14) on the lower border. Nine specimens yield the following measurements (to the nearest mm.) :—

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[1] Kemp, *Mem. Ind. Mus.*, V, p. 203 (1915).

Locality.	Sex.	Total length.	Length of carapace.	Length of 2nd peraeopod.	Second peraeopod: length of Ischium.	Merus.	Carpus.	Palm.	Dactylus.
Lampam	♂	174	42	132	23	25	29	28	25
„	♂	168	46	140	23	26	29	32	29
„	♂	156	39	115	21	22	26	24	20
Singgora	♂	173	46	205	28	44	48	48	37
„	♀	199	53	166	29	33	37	35	29
„	♀	175	42	117	23	23	30	22	16
„	♀	148	34	88	18	18	23	16	12
„	♀	139	32	80	16	15	20	14	11
„	♀	128	29	73	14	14	20	12	10

There are also in the collection two very small individuals, 43 and 46 mm. in total length, that I consider to be young examples of this species. They were obtained in the Patani river, below the town of Patani in the Siamese Malay States.

In the Indian Museum collections I have not been able to find any specimens of *P. carcinus* as small as these; the youngest, which are from Garia, near Calcutta, being 65 and 69 mm. in total length.

In the larger of the Patani river specimens the rostrum extends beyond the antennal scale by about one-quarter its length, and bears 12 teeth above and 10 below. In the smaller individual the rostrum reaches beyond the scale by about one third of its length, and bears 14 teeth above and 11 below. In the young specimens from Garia the rostrum is fully as long as in the smaller Patani individual, and bears 13 or 14 teeth above and 12 or 14 below. The second legs in both Patani specimens reach beyond the end of the scale by the length of the chela—in those from Garia by the chela and fully one-third of the carpus. The segments yield the following measurements (in mm.):—

Locality.	Sex.[1]	Total length.	Length of carapace.	Length of 2nd peraeopod.	Second peraeopod: length of Ischium.	Merus.	Carpus.	Palm.	Dactylus.
Garia, nr. Calcutta	♂	69	14·7	39	7·8	8·1	11·0	6·5	4·6
„ „	?	65	14·0	37	7·6	7·9	10·8	5·8	4·1
Patani river	?	46	9·8	25	5·1	5·2	6·6	3·6	2·4
„ „	?	43	8·4	19·5	4·2	4·3	5·3	3·1	1·8

[1] In the largest specimen, which is evidently a male, the appendix masculina is represented by a small bud: in the others no trace of it can be detected.

The measurements are closely comparable to those of some adult females, the chief difference being that the dactylus is a little shorter in relation to the palm. De Man[1] records a young male specimen of this species, 65 mm. in total length, in which the carpus of the second legs was 9 mm. in length, the palm $4\frac{1}{2}$ mm. and the fingers $2\frac{3}{4}$ mm.

The telson tip in the Patani individuals differs conspicuously from that of adults, the inner pair of subterminal spinules extending beyond the apex by more than half their length. The specimens from Garia represent an intermediate stage, the spinules just reaching the apex.

Lanchester, in his account of the Crustacea of the "Skeat Expedition,"[2] refers to a specimen, 43 mm. in length, under the name *P. carcinus* var. *lamarrei*. This individual is doubtless a young *P. carcinus*, Milne-Edward's *P. lamarrei* being, as de Man has shown,[3] quite distinct from the Fabrician species.

Palaemon carcinus is evidently an abundant species and has a distribution extending from India to New Guinea and the Philippines.

Palaemon lanchesteri, de Man.

1901. *Palaemon paucidens*, Lanchester, *Proc. Zool. Soc. London*, p. 568, pl. xxxiii, fig. 4 (not *P. paucidens*, Hilgendorf, *Sitz-ber. Ges. naturf. Freunde, Berlin*, Jahrg. 1893, p. 155).

1911. *Palaemon* (*Eupalaemon*) *Lanchesteri*, de Man (*nom. nov.* for *P. paucidens*, Lanchester *nec* Hilgendorf), *Notes Leyden Mus.*, XXXIII, p. 264, footnote.

Lanchester, when describing this species, noted that notwithstanding the presence of ovigerous females it might eventually prove to be merely the young of *P. idae*. In my opinion there can be no doubt that the species is valid, its nearest relative being apparently *P. lamarrei*, Milne-Edwards. In both species the secondary sexual characters seem never to be strongly developed and the second peraeopods differ little, if at all, in their proportions from those of the young.

I have little to add to Lanchester's description. The rostrum in its length and dentition agrees with his account. The posterior tooth of the dorsal series is situated on the carapace, the second being as a rule immediately over the orbit; the distance between the first and second is generally not greater than that between the second and third. The apex is nearly always bifid.

The second legs are rather shorter than indicated by Lanchester, those of ovigerous females reaching beyond the scales by scarcely more than the length of the chela, those of males by the chela and not more than one third of the carpus (for measurements see table on p. 258). The apex of the telson is sharply pointed, the inner pair of subterminal spinules extending beyond the tip by more than half their length. The eggs are large, about 1·05 mm. in length and 0·78 mm. in breadth.

Sixteen large specimens and a number of young individuals were obtained by Dr. Annandale at the inner end of the Tale Sap in ponds and ditches of fresh water near Lampam. Lanchester records the species from Singgora, but Dr. Annandale obtained no evidence that it enters the lake at that place.

[1] De Man, *Notes Leyden Mus.*, I, p. 165 (1879).
[2] Lanchester, *Proc. Zool. Soc. London*, 1901, p. 565.
[3] De Man, *Rec. Ind. Mus.*, II, p. 222, pl. xix, fig. 4 (1908).

Sex.	Total length.	Length of carapace.	Length of 2nd peraeopod.	Second peraeopod: length of Ischium.	Merus.	Carpus.	Palm.	Dactylus.
♀ ovig.	41	8·8	18·8	3·9	4·3	6·2	2·2	1·7
♀	38·5	8·2	17·9	3·7	3·7	6·0	2·0	1·6
♂	35	6·7	14·6	3·0	3·3	4·7	1·7	1·2
♂	34·5	6·4	14·2	2·9	3·1	4·8	1·6	1·2

Palaemon nipponensis, de Haan.

1890. *Palaemon nipponensis*, Ortmann, *Zool. Jahrb., Syst.*, V, p. 715.
1902. *Bithynis nipponensis*, Rathbun, *Proc. U.S. Nat. Mus.*, XXVI, p. 53.
1914. *Palaemon nipponensis*, Balas, *Abhandl. math.-phys. Klasse K. Bayer. Akad. Wiss.*, Suppl. Bd. II, Abh. 10, p. 59.

The synonymy has been dealt with by Ortmann; more recent references are supplied by Balss.

A number of specimens which show a considerable amount of variation are referred to this species; they were obtained in China and Japan and the largest, which is from the former country, is only 90 mm. in total length. Miss Rathbun has remarked the close relation that exists between *P. nipponensis* and *P. longipes* and has noted certain points of distinction, but the use of these characters has not enabled me to separate the collection into two groups.

In Japanese specimens from 70 to 85 mm. in length the fingers of the second peraeopods are always shorter than the palm, varying from three quarters to nine tenths of its length; the carpus in specimens with longer fingers is usually more slender, about seven and a half times as long as its distal breadth, while in those with shorter fingers the carpus is generally stouter, hardly more than six times its distal breadth. Distinctions based on these grounds break down entirely when a number of specimens are compared. The upper edge of the rostrum is comparatively straight and in nearly all cases bears 12 or more teeth. I can find no differences in the hairiness or toothing of the fingers of the large chela.

In young Japanese specimens from 40 to 50 mm. in length the degree of variation in the proportions of the chela of the second legs is even greater than in adults, the fingers being a little longer than, equal to, or only three-quarters the length of the palm. The dorsal teeth on the rostrum are as numerous as in adults, whereas, according to Balss, there are only 7 or 8 in young *P. longipes*.

A Palaemonid from Sagami Bay, about 55 mm. in length, received in exchange from the Munich Museum and determined by Balss as *P. longipes*, differs in a conspicuous manner from all the specimens in Dr. Annandale's collection. The rostrum is shorter and more strongly arched above, the carapace is thickly covered with minute spinules, the second legs are proportionately longer and much stouter with the carpus shorter than the palm.[1]

The Japanese specimens were obtained in the Yodo river, about one mile above the town of Osaka and in the lagoon at Kasumi-ga-ura. The Chinese examples were caught in the Tai Hu lake.

Palaemon asperulus, von Martens.

1868. *Palaemon asperulus*, von Martens, *Arch. fur Naturgesch.*, Jahrg. XXXIV, i, p. 43, pl. i, fig. 5.

1890. *Palaemon asperulus*, Ortmann, *Zool. Jahrb., Syst.*, V, p. 708.

This species, which apparently has not been recorded[2] since it was originally described by von Martens in 1868, is represented in Dr. Annandale's collection by ten specimens, obtained in the Tai Hu.

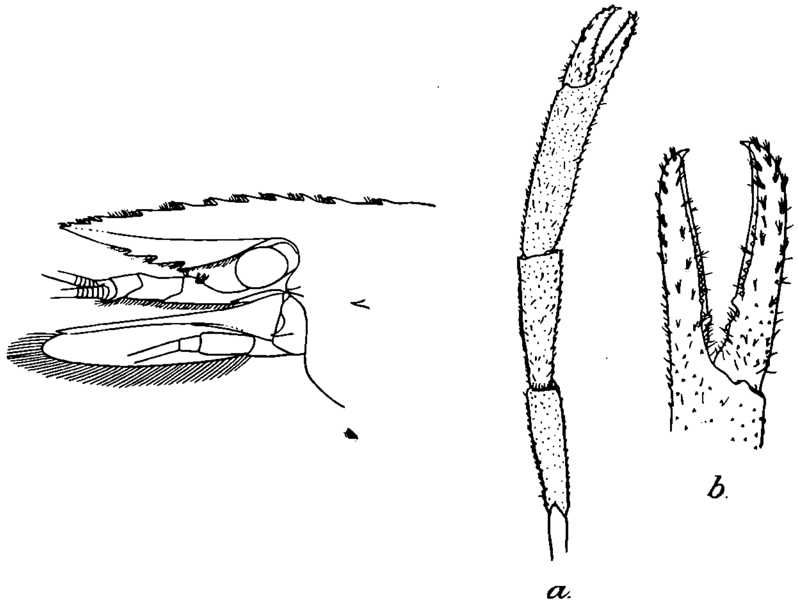

FIG. 8.—*Palaemon asperulus*, von Martens.
Anterior part of carapace, rostrum, etc.
(*a*) Second peraeopod. (*b*) Fingers of same further enlarged.

The largest male is rather smaller than von Marten's type and is 75 mm. in length; in this individual, however, the second peraeopods are noticeably smaller than in one only 63 mm. long.

In the three largest specimens there are a few minute asperities on the carapace behind the eye and below the hepatic spine; the others are almost or quite smooth.

[1] In this respect the specimen differs from the published descriptions of large males of the species.

[2] The specimen which de Man referred to *P. asperulus* in 1904 is apparently a different species (see p. 261).

The rostrum reaches almost to the tip of the antennal scale in adults (text-fig. 8); in the young it is a trifle longer. The upper margin is straight or very slightly convex and bears from 8 to 11 teeth[1]; the hindmost is rather widely separated from the next of the series and the posterior two or three are placed on the carapace behind the level of the orbit. On the lower border there are 2 or 3 large teeth.

The accessory ramus of the outer antennular flagellum is longer than the peduncle.

The second peraeopods (text-figs. 8*a*, *b*) are equal and in well developed males reach beyond the end of the antennal scale by the chela and at least half the length of the carpus; in the largest individual, however, they are proportionately shorter, reaching beyond the same point only by three quarters the length of the chela. Five specimens yield the following measurements:—

Sex.	Total length.	Length of carapace.	Length of 2nd peraeopod.	SECOND PERAEOPOD: LENGTH OF				
				Ischium.	Merus.	Carpus.	Palm.	Dactylus.
♂	75	22·4	42·0	7·0	8·4	9·3	9·6	5·6
♂	63	18·1	52·5	8·4	9·5	10·9	13·3	8·6
♂	57	16·1	50·5	7·7	9·3	10·4	13·4	8·3
♀	49	13·2	38·5	5·9	7·2	8·4	9·2	6·2
♀	43	11·2	30·7	5·5	5·5	7·1	7·0	4·4

It will be noticed that the carpus is decidedly shorter than the propodus in all the larger specimens. In those below 45 mm. in length the proportions are, however, different, the carpus being almost as long, or even (as in the specimen measured) a shade longer than the palm.

In the male 63 mm. in length the carpus is 2·7 mm. in breadth at the distal end, the segment thus being about four times as long as broad. In all the larger specimens the segments bear minute asperities, specially noticeable on the inner and under surfaces of the carpus and propodus where they tend to form longitudinal rows. The fingers bear few hairs; on their inner margins there is a fine ridge extending from the base to the tip; there is a single small tooth at the base of the fixed finger and two in a similar position on the dactylus.

The telson is produced to a sharp apical point which is, however, exceeded by the innermost of the two pairs of terminal spinules.

The specimens collected by Dr. Annandale were found not far from Shanghai, the locality from which von Martens described the species. There is thus little doubt that they represent the true *P. asperulus*.

[1] The rostral formulae in ten specimens are,—8/2, 9/2, 9/3, 9/3, 10/3, 10/3, 10/3, 10/3, 11/3, 11/3.

The female, 45 mm. in length, from South Hu-peh, referred by de Man[1] to *Palaemon* (*Parapalaemon?*) *asperulus*, is without doubt different. In none of Dr. Annandale's specimens can I find any trace of carinae on the first abdominal somite and the peraeopods differ conspicuously from de Man's account. In the case of the Hu-peh specimen the merus of the second leg is 5·2 mm. in length, the carpus 6·4 mm., the palm 7·5 mm. and the fingers 5·5 mm., proportions which differ slightly from those of Shanghai individuals. In the latter specimens, moreover, there is no trace of a longitudinal ridge on the outer side of the merus and carpus. The last three peraeopods are also much stouter in the Hu-peh specimen, the merus of the third pair being only five times, and the propodus seven times as long as broad. In Dr. Annandale's examples the merus of this limb is six and a half times and the propodus about nine times as long as broad.

The specimens were deeply pigmented in life, but without any characteristic markings. They were taken from small basket traps set among weeds in and at the mouths of narrow creeks opening into the Tai Hu. They were found along with *Palaemon nipponensis* and *Leander modestus*, but were much less abundant than either of those species.

Palaemon sundaicus (Heller ?), de Man.

1862. *Palaemon sundaicus*, Heller, *Sitz.-ber. Akad. Wiss. Wien*, XIV, p. 415, pl. ii, figs. 38, 39.
1892. *Palaemon* (*Eupalaemon*) *sundaicus*, de Man, in *Weber's Zool. Ergebn. Reise Niederländ. Ost-Ind.*, II, p. 437, pl. xxvi, fig. 35.
1897. *Palaemon* (*Eupalaemon*) *sundaicus*, de Man, *Zool. Jahrb.*, *Syst.*, IX, p. 779 and X, pl. xxxvii, fig. 71 (1898).
1914. *Palaemon sundaicus*, Cowles, *Philippine Journ. Sci.*, Sect. D, IX, p. 355, pl. ii, figs. 3, 3*a-f*.

To this species I refer a number of rather small specimens in which the chelipedes (after nine months' preservation in alcohol) are deeply mottled with purplish brown. They almost certainly belong to the same species as those with identical colour markings described by de Man and Cowles (*loc. cit.* 1897 and 1914).

De Man has described two varieties of *P. sundaicus* from Atjeh and Batavia, distinguishing the latter under the name var. *bataviana*. Dr. Annandale's specimens agree most nearly with the typical form.

Of the twelve specimens in the collection, ten have 10 or 11 (usually 11) teeth on the upper edge of the rostrum and 5 to 7 (usually 6) on the lower edge. One specimen has 13 dorsal teeth and 6 ventral and one which has clearly suffered injury—the antennal scale on one side being only half its normal size—has 14 teeth above and 11 below. In all cases there are three teeth on the carapace behind the orbital notch. Towards the apex the rostrum is always rather strongly upturned, reaching beyond the antennal scale by a proportion varying from one tenth to one fifth of its length. The carapace is smooth throughout.

The second peraeopods are slender and in the larger specimens reach beyond the scale by rather more than the chela and carpus. The merus, carpus and

[1] De Man, *Trans. Linn. Soc.*, *Zool.* (2), IX, p. 293, pl. xviii, figs. 2-8 (1904).

palm are thickly covered with small spinules which are larger on the inner and under sides of the carpus and palm where they tend to form longitudinal rows. These spinules are visible even in the smallest individuals. In the larger males and the oldest female the fingers are thickly clothed with hair. There are two small teeth on the inner margin of the dactylus near its proximal end and one similar tooth which fits between them on the fixed finger.

Seven specimens yield the following measurements :—

Sex.	Total length.	Length of carapace.	Length of 2nd peraeopod.	Second peraeopod: length of Ischium	Merus.	Carpus.	Palm.	Dactylus.
♂	76	17·5	77	12·1	15·2	23·0	15·2	10·7
♂	71	17·3	61·5	10·4	11·5	16·8	12·1	8·3
♂	53	11·3	42·5	8·0	8·0	12·4	6·5	6·4
♂	43	9·1	32·0	6·0	6·2	8·5	4·7	4·8
♀	76	21·3	67	12·4	14·0	18·6	11·7	8·1
♀	57	13·5	49	8·8	9·2	14·2	8·7	6·3
♂	82	21·7	121	16·8	23·0	40·5	32·0	11·6

It is doubtful if the last of these specimens, which is separately referred to below, is correctly referred to *P. sundaicus*. The measurements of the remainder tend to show that in the course of growth the palm increases considerably in length in proportion to the merus and fingers. In young males it is much shorter than the merus and little if at all longer than the fingers, whereas in large males it is equal to or a little longer than the merus and almost one and a half times as long as the fingers.

In the male 76 mm. in length the carpus is 2·5 mm. in breadth at its distal end and the palm 2·4 mm., the segments being respectively about nine times and six and a third times as long as broad. In the female of the same length these measurements are 2·3 mm. and 2·5 mm., the carpus being eight times and the palm six and two thirds times as long as wide.

If the figures tabulated above are analysed and compared with those given in other descriptions, certain small differences are evident; these, however, do not appear to be sufficiently well marked to afford any basis for the foundation of a subspecies. In the males from the Tale Sap, for instance, the merus and carpus seem proportionately a trifle longer and the palm and dactylus a little shorter than in those described by de Man as *P. sundaicus* var.[1] and the same features may be detected if the Tale Sap females are compared with de Man's typical *P. sundaicus* from the Java Sea.[2]

[1] De Man, *loc. cit.*, 1897, p. 783. [2] De Man, *loc. cit.*, 1897, p. 782.

The large male, the last of those included in the table of measurements, is referred to *P. sundaicus* with very considerable doubt, but is perhaps merely an abnormality. Both legs of the second pair are detached and only one is complete. The rostrum resembles that of the other specimens, extending a little beyond the scale, with an upturned apex and with 10 teeth above and 5 below. The second peraeopod shows very faint traces of mottling, but is proportionately much longer than in the other specimens and exhibits great differences in the relative lengths of the segments. The dactylus is proportionately much shorter and the carpus and palm longer. Cowles (*loc. cit.*) has given the measurements of a number of Philippine specimens of *P. sundaicus* of sizes comparable with this male; but in all of them the fingers are considerably more than half the length of the palm, whereas in Dr. Annandale's specimen they are little more than one third the length.

The specimens in the collection were found in the Tale Sap near Singgora and in pools and ditches in the vicinity; they were obtained in water of specific gravity varying from 1·004 to 1·0085. There are also a few small individuals from the Patani river in the Siamese Malay States. These were found in fresh water, but in a locality subject to tidal influence. Dr. Annandale notes that, in addition to the tortoise-shell-like mottlings on the chelipedes, living specimens showed a small dark spot on each side of each abdominal somite.

Specimens which I regard as specifically identical with those obtained by Dr. Annandale are recorded by de Man from Java, Flores and Celebes and by Cowles from the Philippines. Most other records appear somewhat doubtful.

Henderson and Matthai [1] regard *P. sundaicus* as a synonym of *P. idae*, but I am not at present prepared to follow them in this view. The specimens I have examined seem to differ conspicuously in the form of the rostrum from any of those which they have recorded from S. India under the latter name. *P. sundaicus* was described by Heller from a very young specimen and its true identity is still uncertain. The notes made by Koelbel on the type and published by de Man [2] have led the latter author [3] and Coutière [4] to suggest the possibility of its identity with von Martens' *P. dispar* and this view seems to have more to recommend it than that adopted by Henderson and Matthai. If proved it will, however, have unfortunate consequences, for *P. dispar* must then be known as *P. sundaicus*, while a new name will probably be necessary for the form described above.

De Man (*loc. cit.*, 1897) has also suggested that Heller's *P. sundaicus* may be specifically identical with Dana's *P. equidens* from Singapore. But Dana's species was described from a mutilated specimen which, apparently, is not now in existence. It is exceedingly improbable that the species will ever be recognised with certainty and it is best that it should be altogether ignored in future work.

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[1] Henderson and Matthai, *Rec. Ind. Mus.*, V., p. 285 (1910).

[2] De Man, *loc. cit.*, 1892, p. 437.

[3] De Man, *loc. cit.*, 1897, p. 781.

[4] Coutière, *Ann. Sci. nat., Zool.* (8), XII, p. 335 (1901).

Palaemon elegans, de Man.

1892. *Palaemon (Eupalaemon) elegans*, de Man, in *Weber's Zool. Ergebn. Reise Niederländ Ost.-Ind.*, II, p. 440, pl. xxvi, fig. 36.

1903. *Palaemon (Eupalaemon) elegans*, de Man, *Abhandl. Senck. naturf. Ges., Frankfurt*, XXV, p. 764.

The specimens in the collection are from Patalung in Lower Siam. They agree closely with the original description and also with an adult male from Buitenzorg determined by de Man and preserved in the Indian Museum: there are, however, slight differences in the form of the rostrum.

In Javanese specimens the upper edge of the rostrum is usually convex and at the apex is straight or directed a little downwards. In those from Patalung the upper edge is usually a trifle sinuous and the apex is straight, or (more particularly in young males and females) directed a little upwards. The teeth on the upper edge vary in number from 9 to 13,[1] with 2 or 3 situated on the carapace, thus agreeing exactly with de Man's account. On the lower edge, however, there are from 4 to 6 teeth (usually 4 or 5),[2] whereas in Javanese specimens there are only 2 or 3 and rarely 4.

The spinules on the carapace of the male, except in the case of the largest specimen, are restricted to the lateral walls and to the region in the vicinity of the hepatic spine.

The identity of the Patalung specimens with *P. elegans* is proved beyond doubt by the form of the chelae of the adult male which agree in every particular with those of the specimen from Buitenzorg referred to above. The fingers are clothed with hair in their basal two-thirds, with teeth at their proximal end exactly as described by de Man, while the movable finger bears distally the characteristic double row of tubercles. Seven specimens yield the following measurements:—

Sex.	Total length.	Length of carapace.	Length of 2nd peraeopod.	Second peraeopod: length of Ischium.	Merus.	Carpus.	Palm.	Dactylus.
♂	61	16·5	8	9·9	16·7	23·5	18·5	15·6
♂	57	15·7	71·5	10·4	14·0	19·7	13·4	14·0
			54	8·0	11·4	13·7	10·8	9·4
♂	58	14·3	65	9·4	13·0	19·1	13·5	11·6
♂	60	14·2	43	7·1	8·5	11·7	7·9	7·7
♂	49	12·2	37·7	6·5	7·7	9·7	7·3	6·5
♀ ovig.	47	11·3	31·5	5·4	5·7	8·8	5·1	4·3
♀ ovig.	40	9·7	24·5	4·7	4·9	6·6	3·9	3·5

1 Of twenty-three specimens two have 9 dorsal teeth, seven have 10, nine have 11, four have 12 and one has 13.

2 Of twenty-three specimens twelve have 4 ventral teeth, ten have 5 and one has 6.

The eggs are very large, about 1·5 mm. in length and 1·15 mm. in breadth. One specimen is parasitised by a Bopyrid.

It appears to me probable that the six larger specimens recorded by Lanchester from the Tale Sap under the name *Palaemon nipponensis* [1] are in reality examples of this species. De Man has noted the great resemblance that exists between the two forms and judging from Dr. Annandale's collection *P. nipponensis* does not occur in Lower Siam. The rostrum in Lanchester's larger specimens bears 10 or 11 teeth above and 4, 5 or 6 below, agreeing with the individuals described above. Lanchester's smaller examples with 6, 7 or 8 teeth on the upper border of the rostrum and 3, 4 or 5 below, probably belong to some other species; in young *P. elegans* that I have examined the rostral formula is the same as in adults.

Dr. Annandale's specimens of *P. elegans* were obtained at Lampam in Patalung in fresh water. They were found in the Patalung river and in ponds and ditches in the vicinity. In the Tale Sap itself the species was not found. *P. elegans* is recorded by de Man from Buitenzorg and Sinagar in Java.

Palaemon neglectus, de Man.

1888. *Palaemon acutirostris*, de Man (*nec* Dana), *Journ. Linn. Soc.*, XXII, p. 280, pl. xviii, fig. 7.

1891. *Palaemon acutirostris* (de Man *nec* Dana), Ortmann, *Zool. Jarhb., Syst.*, V, p. 707.

1892. *Palaemon* (*Eupalaemon*) *equidens*, de Man (*nec* Dana), in *Weber's Zool. Ergebn. Reise Niederländ. Ost-Ind.*, II, p. 453, pl. xxvi, fig. 37 (*not the synonymy*).

1906. *Palaemon* (*Eupalaemon*) *neglectus*, de Man, *Notes Leyden Mus.*, XXVI p. 201, pl. xv, fig. 6.

To this species belong a number of specimens obtained by Dr. Annandale in the Botanical Gardens at Penang.

The rostrum is a little shorter than the antennal scales; its upper margin is straight or a little convex near the base and is a trifle upturned at the tip. On the dorsal edge there are from 11 to 13 teeth (usually 12),[2] of which the three hindmost are placed on the carapace, the fourth being immediately above the posterior limit of the orbit. On the lower edge there are 4 or 5 teeth (nearly always 4).[3]

The largest male, a specimen 88 mm. in total length, bears a great number of very small spinules on the carapace; but these are absent in all the other examples. Six specimens yield the measurements shown on the next page.

The proportions of the segments of the second peraeopods are rather variable. In males the carpus is usually shorter than the merus or equal in length with it, whereas in females it is a little longer than the merus. In the larger claw of the largest male the fingers are a little longer than the carpus; in all other cases they are decidedly shorter. In males the chelipedes are always stout; in the larger limb of the male 88 mm. in total length the merus is 4·7 mm. thick at its distal end and the carpus 5·0 mm.; the palm is very slightly flattened, being 5·4 mm. in breadth and 4·9 mm. in thickness.

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[1] Lanchester, *Proc. Zool. Soc. London*, 1901, p. 566.

[2] Of fifteen specimens three have 11 dorsal teeth, nine have 12, two have 13 and one abnormal individual has 9.

[3] Of fifteen specimens fourteen have 4 ventral teeth and one has 5.

Sex.	Total length.	Length of carapace.	Length of 2nd peraeopod.	Second peraeopod: length of Ischium.	Merus.	Carpus.	Palm.	Dactylus.
♂	88	25·6	84	10·8	16·1	15·5	23·5	15·8
			72	10·4	14·9	13·8	17·9	12·3
♂	72	19·5	54	8·3	10·4	10·2	13·2	9·5
			44	7·7	8·8	8·8	9·6	7·3
♂	66	17·5	45·5	7·5	9·1	8·7	11·1	7·2
			37·5	6·6	7·9	7·9	8·2	5·8
♂	75[1]	20·5	50·5	8·1	11·0	10·3	12·4	7·8
			43	7·6	9·3	8·7	9·4	6·6
♀	53	13·1	32·5	5·6	6·6	7·1	7·3	5·1
			30	5·2	6·5	6·8	6·4	4·8
♀	43	11·0	28·5	4·9	5·7	6·0	5·7	4·5
			25	4·5	5·0	6·0	4·7	3·9

The spinules on the chelipedes agree closely with de Man's description. On the outer surface of the carpus there is a comparatively broad longitudinal smooth line which separates the closely packed small spinules of the upper surface from the very much larger and more sparsely distributed spinules of the lower surface.

In the largest male there are on both chelae five teeth on the fixed finger and four on the dactylus; in the smaller individuals they are less numerous, two or three on each finger. The anterior tooth on the dactylus is placed a little behind its middle point, the foremost on the fixed finger being posterior to it. These two teeth are larger than any of the others and the margin behind each of them is distinctly concave.

The synonymy of *P. neglectus* has been dealt with by de Man. In the Indian Museum there are two of the specimens which he recorded from Mergui in 1888 under the name *P. acutirostris*. These appear to be specifically identical with those described above, but unfortunately all the chelipedes are missing except one, which is small.

The specimens obtained by Dr. Annandale were found in a rapid running stream in the Botanical Gardens at Penang. All of them, in life, bore a small black spot on each side of the abdomen at the junction of the 1st and 2nd, 2nd and 3rd, 4th and 5th and 5th and 6th abdominal somites. No spot occurred at the junction of the 3rd and 4th somites. In the smaller individuals there was a dark slanting line near the posterior margin of the carapace and another, similar to it, not far from the anterior

[1] Both chelipedes detached.

margin, the two sometimes being joined together to form an N-shaped figure. In the largest male the carapace was olivaceous green, marbled and streaked and without definite markings. The chelipedes in this specimen were blackish externally and pale olive internally, the fingers being black with white tips. In smaller individuals the chelipedes were olive, with white fingers and with two scarlet bars on the chela. The first of these was situated at the proximal end of the palm and the second at the base of the fingers. The walking legs bore alternate pale and dark bars.

Palaemon neglectus has hitherto been recorded from King I. and Elphinstone I. in the Mergui Archipelago and from Deli on the E. coast of Sumatra.

Palaemon pilimanus, de Man.

1891. *Palaemon pilimanus*, Ortmann, *Zool. Jahrb.*, *Syst.*, V, p. 735, pl. xlvii, fig. 9.
1892. *Palaemon* (*Macrobrachium*) *pilimanus*, de Man, in Weber's *Zool. Ergebn. Reise Nied Ost-Ind.*, II, p. 471, pls. xxvii and xxviii, figs. 44, *a-i*.
1900. *Palaemon* (*Macrobrachium*) *pilimanus*, Borradaile, *Proc. Zool. Soc. London*, p. 93.
1901. *Palaemon pilimanus*, Lanchester, *Proc. Zool. Soc. London*, p. 567.

A large number of specimens collected in Java by the late Dr. W. C. Hossack belong to this variable species; they agree with de Man's description and with three Javanese specimens determined by de Man and preserved in the Indian Museum.

About sixty specimens, including one ovigerous female, were obtained in the Government Quinine Gardens at Tijnproean, at an altitude of 5600 ft., while two others were found at Garoet at an altitude of about 3000 ft. The ovigerous female is 45 mm. in total length and the largest male 59 mm.

The species is known from Java, Sumatra and Borneo and on the continent of Asia from Aring in Kelantan and the Belimbing River.

Palaemon lampropus, de Man.

1892. *Palaemon* (*Macrobrachium*) *lampropus*, de Man, in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 493, pl. xxix, figs. 49*a-c*.
1901. *Palaemon lampropus*, Lanchester, *Proc. Zool. Soc. London*, p. 568.
1902. *Palaemon lampropus*, Schenkel, *Verh. naturf. Ges. Basel*, XIII, p. 511.

Fifteen specimens were obtained by Dr. Annandale in the Patani River, below the town of Patani in the Siamese Malay States. The series agrees very well with de Man's account, but the rostrum is longer than in the large male that he described in detail, reaching to, or even a little beyond the apex of the scale. There are from 15 to 18 teeth on the upper border of the rostrum[1] of which 3 or 4 (usually 4) are situated on the carapace behind the orbit. On the lower margin there are 3 or 4 teeth, usually 4.

The specimens are small, the largest being only about 45 mm. in length; the chelipedes in several individuals are equal and in no case do they reach beyond the antennal scale by more than the length of the chela. In their form, however, and in the dentition of the fingers they are in precise agreement with de Man's description.

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[1] Of fifteen specimens two have 15 dorsal teeth, six have 16, five have 17 and two have 18.

The series includes several ovigerous females, each bearing a great number of very small eggs.

Palaemon lampropus is known to occur in Celebes and Timor and has been recorded by Lanchester from Aring in Kelantan. The number of dorsal teeth on the rostrum in Lanchester's specimens (12 or 13) is considerably lower than in any of those found by Dr. Annandale.

Genus **Leander**, Desmarest.

In a recent paper in the *Records of the Indian Museum* I have revised the section of this genus that comprises Milne-Edward's *Leander styliferus* and related forms. This paper contains descriptions and figures of three of the five species obtained by Dr. Annandale in the course of his tour.

Leander annandalei, Kemp.

1917. *Leander annandalei*, Kemp, *Rec. Ind. Mus.*, XIII, p. 211, text-figs. 1·4.

This remarkable species is based on a single individual dredged in the Whangpoo River, between Shanghai and Woosung, at a depth of 5½ to 7½ metres. It was found in pure fresh water.

Leander annandalei is particularly interesting in that it forms a link between *L. tenuipes*, Henderson, in which the last three pairs of legs are excessively long and filiform, and more normally constituted species of the genus.

Leander modestus, Heller.

1917. *Leander modestus*, Kemp, *Rec. Ind. Mus.*, XIII, p. 221, pl. ix, fig. 1.

From material obtained by Dr. Annandale at Shanghai I have been able to draw up a fresh description of this species, which was hitherto known only from the account given by Heller more than fifty years ago.

The species is common at the margins of the Tai Hu Lake and is caught in large numbers in basket traps set among weeds. A few individuals were dredged from a bare muddy bottom in the middle of the lake and others were obtained in the Whangpoo River between Shanghai and Woosung at depths of 5½ to 7½ metres. Young examples are common in ditches and ponds in the neighbourhood of Shanghai. All the specimens were obtained in pure fresh water.

In redescribing this species I unaccountably omitted to notice that Henderson in 1893 recorded *Leander modestus* from Madras. I have recently obtained from this locality specimens of a form which is without doubt identical with that examined by him. The specimens are, in my opinion, to be referred to *L. semmelinki*, a species which in many respects bears a close resemblance to *L. modestus*.

Leander semmelinki, de Man.

1881. *Leander semmelinkii*, de Man, *Notes Leyden Mus.*, III, p. 137.
1890. *Leander semmelinkii*, Ortmann, *Zool. Jahrb.*, *Syst.*, V, p. 517.
1893. *Leander modestus*, Henderson (*nec* Heller), *Trans. Linn Soc.*, *Zool.* (2), V, p. 441.
1903. *Leander semmelinkii*, Nobili, *Boll. Mus. Torino.* XVIII, no. 455. p. 8.

The specimens agree almost precisely with de Man's account. The only discrepancy that I have noted is that the lower border of the rostrum, described as "scarcely emarginate at the base," is, as in most species of the genus, distinctly concave above the eye, being at its narrowest only about two-thirds as deep as in the vicinity of the hindmost inferior tooth.

The rostrum bears from 7 to 10 dorsal teeth, usually 8 or 9; the first is remote from the others and is situated on the carapace, the second being as a rule immediately above the hinder limit of the orbit. On the lower border are from 2 to 5 teeth, nearly always 3.

The branchiostegal tooth is not very much smaller than the antennal. The outer margin of the basal segment of the antennular peduncle ends in a spine that extends much beyond the produced, setose, antero-external portion of the segment. The two rami of the outer antennular flagellum are fused basally for a distance varying from two-fifths to one half the entire length of the shorter ramus. The antennal scale is about three times as long as wide, narrowed apically and with the distal end of the lamella not extending very far beyond the terminal spine of the outer margin.

The mandibular palp is composed of only two segments, the joint between the second and third being suppressed. In this respect the species is comparable to the European *L. squilla* in which precisely the same modification is found.

The chela of the second peraeopods is nearly always a trifle longer than the carpus, but is occasionally about equal to it, as noted by Ortmann. In reference to the last three pairs of peraeopods de Man remarks, "end of the terminal joint armed with three small and two longer spines." This is doubtless a clerical error, the segment referred to being the propodus. The description, thus amended, applies well enough to the third and fourth pairs; in the fifth the spinules are much more numerous towards the distal end. In the third pair the propodus is one and three quarter times the length of the carpus and two and a third times as long as the dactylus. In the fifth pair the propodus is longer both relatively and actually; it is about twice the length of the carpus and three and a quarter times as long as the dactylus. The sixth abdominal somite, measured dorsally, is rather more than half the length of the carapace.

The largest specimen in the collection is a female, 40 mm. in total length. The eggs are of medium size, about 0·73 × 0·58 mm. in longer and shorter diameter.

The rostrum is proportionately longer in small specimens than in adults.

L. semmelinki, as de Man has remarked, bears a rather close resemblance to Heller's *L. modestus*; but in the latter species (i) the basal crest of the rostrum is much more elevated, (ii) the interval between the 1st and 2nd dorsal teeth of the rostrum is not greater than that between the 2nd and 3rd, (iii) the two rami composing the outer antennular flagellum are fused for a shorter length, (iv) the antennal scale is parallel-sided, not narrowed distally, (v) the mandibular palp is composed of three segments, (vi) the fingers of the first peraeopod are nearly one and a half times as long as the palm, (vii) the fingers of the second peraeopod are conspicuously longer than the palm and (viii) the last three peraeopods are more slender, with a proportionately longer dactylus, that of the third pair being three quarters the length of the propodus.

The specimens collected by Dr. Annandale were obtained in February, 1914, in brackish water at the mouth of the Prai River opposite Penang; the species was extremely abundant in very shallow water at the edge of mud flats and, when alive, was whitish in colour without definite markings.

Other examples in the Indian Museum are from Fisher Bay, Port Owen, Tavoy I., Burma, obtained in November, 1911, by the R.I.M.S. 'Investigator' and from Bandra, near Bombay, collected in February 1911 by Mr. J. W. Caunter, from Ennur backwater near Madras, collected by myself in May 1918 in water of specific gravity 1·02625. There are ovigerous specimens from all the localities.

Leander semmelinki has been recorded from the roads of Makassar in Celebes (de Man), from Luzon in the Philippines (Ortmann) and from Singapore (Nobili).

Leander potamiscus, Kemp.

1917. *Leander potamiscus*, Kemp, *Rec. Ind. Mus.*, XIII, p. 225, text-fig. 7.

This species, which has been described from material collected by Dr. Annandale, differs from all known members of the genus with the exception of *L. fluminicola*, Kemp, in the complete absence of the branchiostegal spine of the carapace.

The type specimens were collected by Dr. Annandale in the Patani River, below the town of Patani in the Siamese Malay States and the species was also found at Telok Tikus on Penang I. Other specimens in the collection of the Zoological Survey of India are from Middle I., in the Andaman group and from the Sanguem and Tuari Rivers in Portuguese India. All the specimens were found in fresh water, but in places subject to tidal influence.

Leander paucidens (de Haan).

1907. *Leander paucidens*, de Man, *Trans. Linn. Soc. Zool.* (2), IX, p. 409.
1914. *Leander paucidens*, Balss, *Abhandl. math.-phys. Klasse K. Bayer. Akad. Wiss.*, Suppl. Bd. II, Abh. 10, p. 58.

Of this species, which is by far the commonest freshwater prawn in Japan, large numbers of specimens were obtained by Dr. Annandale. There are long series from Lake Biwa and from Ogura pond near Kyoto and other less numerous examples from the Yodo R., 1 mile above Osaka, from Kasumi-ga-ura on the Pacific coast and from Sapporo in Hokkaido: the specimens from the last locality were presented by the Otsu laboratory. All were collected in fresh water and a number of the females bear eggs.

The species was found in all parts of Lake Biwa, but was most abundant near the shore. Individuals were obtained in nets hauled in deepest part of the lake, at a depth of 320 ft., and as the species appears to live exclusively on the bottom there is every probability that they actually came from the depth indicated. Specimens from over 200 ft. are all small, none exceeding 35 mm. in length; nearer the shore larger examples, up to 48 mm. in length, were obtained. The largest specimens in the collection are from Kyoto and Sapporo and reach a length of about 54 mm. Miss Rathbun[1] has remarked that examples from the sea are larger than those from fresh water, attaining a length of 66½ mm. Dr. Annandale's specimens from Lake Biwa are, however, considerably larger than any that she examined from that locality.

According to an excellent colour sketch, made by Dr. T. Kawamura of the Otsu laboratory, living specimens are closely mottled with dull olive green with a dark posterior border to each abdominal somite. On either side of the carapace are three characteristic dark lines; two of these are on the branchiostegal wall and are nearly vertical, converging a little as they approach the inferior margin; the third extends obliquely downwards and forwards from the cardiac region, running between the two other lines at its lower end. The articulations of all the leg segments are tinged with yellow; there are dark patches at the base of the pleopods and at the tip of each uropod there is a large pale spot bordered with purplish brown. Dr. Annandale notes that specimens from bare ground, either in deep or shallow water, were almost colourless, though still retaining traces of the characteristic markings on the carapace. Examples with the deepest colouration were found among dense weed at a depth of about 10 ft.

The species forms one of the most important commercial products of Lake Biwa, being caught near Otsu in very large numbers in small basket traps.

De Man has given a list of the localities from which *Leander paucidens* has been recorded. It is evidently abundant in all parts of Japan and is known from Hokkaido and the Kurile Is. Miss Rathbun has recorded it from Fusan in Korea.

Genus **Palaemonetes**, Heller.

1911. *Allocaris*. Sollaud, *Bull. Mus. d'Hist. nat. Paris*, p. 50.

1913. *Allocaris*, synonymous with *Palaemonetes*, Pesta. *Ann. K.-K. Hofmuseums Wien*, XXVII, p. 9.

1914. *Contierella*, Sollaud, *Bull. Soc. zool. France*, XXXIX, p. 318.

A small Palaemonid, obtained by Dr. Annandale in fresh water in the vicinity of Shanghai, is without doubt identical with that described by Sollaud under the name *Allocaris sinensis*. The new genus created for this species differs from *Palaemonetes* only in two points,—the wide separation of the coxal and basal segments of the first maxillipedes and the greater number of plumose setae at the apex of the telson.

Sollaud was apparently so impressed with the importance of these characters that he regarded *Allocaris sinensis* as the representative of an isolated branch which had evolved independently of all other Palaemonidae. His views, however, have been severely criticised by Pesta, who regards *Allocaris* as a synonym of *Palaemonetes* and has even expressed the opinion that *A. sinensis* is nothing more than a local race of the European *P. varians*. No two views could possibly be more divergent.

In reference to the characters noted above, Pesta has shown that the form of the first maxillipede is very variable in *Palaemonetes varians*, in some cases bearing an exceedingly close resemblance to that of *Allocaris*, while the number of setae at the

[1] Rathbun, *Proc. U.S. Nat. Mus.*, XXVI, p. 51 (1902).

apex of the telson is, in the same species, by no means constant. I have checked Pesta's observations by an examination of Irish specimens of *P. varians* and can in a large measure substantiate his statements.[1] Consideration of the text-figures which Pesta has given, affords convincing proof that *Allocaris* is nothing more than a synonym of *Palaemonetes* and that Sollaud formed a completely erroneous estimate of the value of the characters he discovered. On the other hand Pesta is undoubtedly wrong in suggesting that the Chinese species is merely a local race of *P. varians*.

More recently Sollaud has described another genus, *Coutierella*, based on a fresh-water Palaemonid from South China, and this also must be relegated to the synonymy of *Palaemonetes*. *Coutierella* is distinguished from *Palaemonetes* only by the form of the second maxilla and first maxillipede, the latter bearing a very close resemblance to the same appendage in *Palaemonetes sinensis*, while the former appears to differ from that of all Palaemonids in which it has been examined in the absence of the re-entrant angle in the margin below the two distal laciniae and in the presence of setae on this margin. It is clear from Pesta's work that the characters drawn from the first maxillipede do not form a valid generic distinction, and even in the Palaemonidae, in which genera are separated by such comparatively slight distinctions, the features of the second maxilla cannot by themselves be held to have the importance that Sollaud has ascribed to them.

In describing Caridea a study of the mouth-parts is far too often neglected; it is much to be regretted, therefore, that Sollaud in his discovery of certain most interesting points in the structure of these appendages in the Chinese species of *Palaemonetes* has adopted such extreme views regarding their evolution and classification.

Palaemonetes sinensis (Sollaud).

1911. *Allocaris sinensis*, Sollaud, *Bull. Mus. d'Hist. nat.* p. 50, text-figs. 1, 2.

This species is certainly not a local race of *P. varians* as suggested by Pesta (*loc cit.*). It may be distinguished by the following characters:—

(i) The teeth on the upper border of the rostrum extend nearer to the apex. In *P. varians* the distal quarter of the rostrum is usually unarmed, whereas in *P. sinensis* it bears a tooth. In *P. sinensis* the foremost tooth of the dorsal series is situated above, or in advance of, the distal tooth on the lower border; in *P. varians* the foremost inferior tooth is in advance of all those on the upper edge.

(ii) The two ultimate segments of the antennular peduncle are proportionately shorter and the free portion of the accessory antennular ramus is nearly four times as long as the fused basal part. In *P. varians* the fused portion is very much longer, the free part of the accessory ramus being only about one third its length.

(iii) The antennal scale is a little broader (about two and two third times as long as wide) and is a trifle more broadly rounded distally.

(iv) The coxa and basis of the first maxillipede are more widely separated.

[1] In a number of Irish specimens the form of the first maxillipede is intermediate between those shown in Pesta's figs. 9 and 10 and in some it is almost as extreme as in fig. 10. There are as a rule only two setae at the apex of the talson, but in a few examples four were found.

(v) In the second peraeopods the chela is equal in length with the merus and is only about two-thirds as long as the carpus. In *P. varians* the chela is decidedly longer than the merus and only a little shorter than the carpus.

(vi) The dactylus of the last three peraeopods is a little longer; that of the third pair is about half as long as the propodus in *P. sinensis*, rather less in *P. varians*.

(vii) There are more setae (9 or 10) at the apex of the telson.

In other respects the two species appear to be in close agreement.

The teeth on the upper border of the rostrum vary in number from 4 to 6,[1] the hindmost being placed on the carapace behind the level of the orbit. On the lower margin there are from 1 to 3 teeth.[2]

On the ciliated margins of the antennules and buccal appendages there are numerous small cysts of a Protozoan apparently identical with that described by Sollaud.

Sixteen specimens of *Palaemonetes sinensis* were obtained by Dr. Annandale in the vicinity of Shanghai in small ponds and ditches of fresh water. They were found in the month of October in company with *Caridina* and young *Leander modestus*: none of the females carry eggs.[3]

Family ALPHEIDAE.

Genus **Alpheus**, Fabricius.

Alpheus paludicola, Kemp.

1915. *Alpheus paludicola*, Kemp, *Mem. Ind. Mus.*, V, p. 303, pl. xiii, figs. 11-13.

The only difference I am able to detect between specimens collected by Dr. Annandale in Lower Siam and those originally described from the Chilka Lake in Orissa is that the rostrum is very slender and rather longer, extending considerably beyond the end of the orbital hoods. In the form of the chelae and in all other particulars there is precise agreement. The eggs are 1·3 or 1·4 mm. in diameter.

According to Dr. Annandale's notes the specimens differed somewhat in colour from those observed in the Chilka Lake, the transverse bands of pigment on the abdomen being missing. They were translucent, without definite markings, but tinged, owing to the presence of scattered chromatophores, with reddish brown. The eyes were black and the palm and fingers of both chelae were deeply tinged with blue, especially on the dorsal surface. The eggs were pale green.

The specimens were obtained in the Tale Sap, in the channel connecting the upper and lower lakes at a depth of 3½ to 8 metres. They were found in a shallow layer of dense mud overlying a coarse sandy bottom and occurred in company with *Upogebia heterocheir*. The specific gravity of the water in the channel was variable according to the state of the tide, but probably does not rise much above 1·004.

Alpheus paludicola has hitherto been found only in the Chilka Lake on the Orissa coast of India.

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[1] Of sixteen specimens five have 4 dorsal teeth, ten have 5 and one has 6.

[2] Of sixteen specimens seven have 1 inferior tooth, eight have 2 teeth and one has 3.

[3] See Addendum, p. 297.

Family ATYIDAE.

Genus **Caridina**, Milne-Edwards.

All the species recorded below possess epipods at the base of the first four peraeopods and a gill-formula which is apparently the same as that given for the genus by Calman and Bouvier.[1]

Caridina propinqua, de Man.

1908. *Caridina propinqua*, de Man, *Rec. Ind. Mus.*, II, p. 227, pl. xix, figs. 6, 6*a-f*.
1913. *Caridina propinqua*, Bouvier, *Trans. Linn. Soc. Zool.* (2), XV, p. 463.
1915. *Caridina propinqua*, Kemp, *Mem. Ind. Mus.*, V, p. 309.

The specimens agree closely with those from the neighbourhood of Calcutta. In young individuals the rostrum extends little, if at all, beyond the end of the basal segment of the antennular peduncle, whereas in adults it almost or quite reaches the end of the second segment. On the upper border there are from 11 to 20 teeth,[2] of which from 2 to 4 (usually 3 or 4) are situated on the carapace. On the lower border there are from 0 to 4 teeth (usually 2).

The carpus of the first peraeopods is from 2·8 to 3·2 times as long as broad. In the third pair the propodus is from 2·7 to 3·2 times the length of the dactylus; the latter segment is slender and is armed with 6 or 7 spines, the terminal claw included. The propodus of the fifth peraeopod is from 2·4 to 2·8 times the length of the dactylus, the latter segment bearing from 43 to 55 spinules. There are from 11 to 16 movable spines on the outer uropod.

The eggs are from 0·64 mm. in length by 0·39 mm. in breadth, when freshly extruded, to 0·70 mm. in length by 0·44 mm. in breadth, when on the point of hatching. Ovigerous females vary greatly in size, being from 12 to 20 mm. in total length.

Dr. Annandale found *Caridina propinqua* in abundance in the Tale Sap in January and February, 1916. It occurred among weeds in all parts of the lake, both in the inner portion where the water is in all probability fresh throughout the year and in the outer lake near the island of Koh Yaw in water of low salinity. There are also numerous specimens in the collection from the Patani River, below the town of Patani in the Siamese Malay States. The water in this locality, though fresh at the time the specimens were obtained, is subject to tidal influence.

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1 Bouvier, *Ann. Sci. France Belgique*, XXXIX, p 68 (1905).

2 In fifty specimens the numbers of rostral teeth are as follows:—

Dorsal teeth.	Ventral teeth.
2 specimens have 11 teeth.	1 specimen has no tooth.
3 ,, ,, 12 ,,	6 specimens have 1 ,,
2 ,, ,, 13 ,,	30 ,, ,, 2 teeth.
7 ,, ,, 14 ,,	12 ,, ,, 3 ,,
8 ,, ,, 15 ,,	1 specimen has 4 ,,
8 ,, ,, 16 ,,	
9 ,, ,, 17 ,,	
6 ,, ,, 18 ,,	
3 ,, ,, 19 ,,	
2 ,, ,, 20 ,,	

Caridina propinqua has hitherto been recorded only from the vicinity of Calcutta and from the Chilka Lake and the neighbourhood of Puri in Orissa.

Caridina nilotica, Roux,
subsp. gracilipes, de Man.

1892. *Caridina wyckii*, var. *gracilipes*, de Man, in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 393, pl. xxiv, figs. 29, *a-c*.
1902. *Caridina wyckii gracilipes*, Schenkel, *Verh. naturf. Ges. Basel*, XIII, p. 498, pl. viii, fig. 5 (in part).
1904. *Caridina wyckii* var. *gracilipes*, Roux, *Rev. Suisse Zool.*, XII, p. 554.
1905. *Caridina nilotica* var. *gracilipes*, Bouvier, *Ann. sci. France Belgique*, XXXIX, p. 73.
1908. *Caridina nilotica* var. *bengalensis*, de Man, *Rec. Ind. Mus.*, II, p. 265, pl. xx, figs. 6, 6*a*, 6*b*.
1908. *Caridina nilotica* var. *gracilipes*, de Man, *ibid.*, p. 207, pl. xx, figs. 7, 7*a*, 7*b*.
1915. *Caridina nilotica* var. *bengalensis*, Kemp, *Mem. Ind. Mus.*, V, p. 307.

I have already drawn attention to the fact that Indian specimens of *C. nilotica* subsp. *bengalensis* show a greater range of variation than is indicated by de Man and that in consequence it becomes almost impossible to separate the Indian race from the subsp. *gracilipes*, described from Celebes.

A short series of specimens obtained by Dr. Annandale at Shanghai still further emphasizes the close relationship that exists between the two races, and I am therefore forced to the conclusion that *bengalensis* must be regarded merely as a synonym of *gracilipes*. In a few points differences may certainly be detected between the forms inhabiting India, Celebes and N. China, but these in my opinion are too trivial to justify nomenclatorial recognition; in most cases they can only be discerned by taking the average characters of a large number of specimens and they are clearly of far less weight than those employed in the case of other subspecies.

In the Shanghai specimens the rostrum reaches a little beyond the end of the antennal scale and is armed dorsally at its proximal end with from 10 to 20 teeth (usually 12 to 17).[1] Of these the first 1 or 2 are placed on the carapace behind the orbital notch. At the apex there are from 1 to 3 dorsal teeth (nearly always 1); in no case are there any isolated teeth between these and the foremost of those comprising the proximal series. The teeth on the lower border are from 6 to 14 in number, usually 7 to 12.[1]

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[1] In thirty-three specimens the numbers of teeth are as follows:—

Dorsal teeth. (Proximal series only.)

1	specimen has	10	teeth.
1	,, ,,	11	,,
3	specimens have	12	,,
4	,, ,,	13	,,
6	,, ,,	14	,,
3	,, ,,	15	,,
7	,, ,,	16	,,
4	,, ,,	17	,,
1	specimen has	18	,,
1	,, ,,	19	,,
2	specimens have	20	,,

Ventral teeth.

1	specimen has	6	teeth.
3	specimens have	7	,,
2	,, ,,	8	,,
8	,, ,,	9	,,
9	,, ,,	10	,,
6	,, ,,	11	,,
2	,, ,,	12	,,
1	specimen has	13	,,
1	,, ,,	14	,,

The carpus of the first peraeopods is from 2·0 to 2·2 times as long as wide. The propodus of the third peraeopod is from 2·9 to 3·3 times as long as the dactylus. The dactylus bears from 9 to 11 spines; excluding which it is from 3·8 to 4·2 times as long as broad. In the fifth peraeopods the propodus is from 2·7 to 3·1 times as long as the dactylus; the latter segment is from 4·8 to 5·2 times as long as broad and bears from 42 to 50 spinules. There are 8 or 9 movable spines on the outer uropod.

The eggs are from 0·50 to 0·52 mm. in length and from 0·31 to 0·32 mm. in breadth.

Dr. Annandale was unable to recognise any difference in colouration between these specimens and those of *C. denticulata* subsp. *sinensis* taken with them, though he noted that two species were probably present in the Shanghai ditches.

As regards the number of rostral teeth it will be noticed that the average of the dorsal series is 15 in the case of the Shanghai specimens, about 15·8 in de Man's examples from Celebes and from 16·8 to 22·7 in various samples from the coasts of India and Ceylon (*v.* Kemp, *l.c.*, 1915, p. 308). In this respect, therefore, the Shanghai specimens are in close agreement with those from Celebes. The teeth on the lower margin are much less numerous than usual; the average number in the Shanghai examples is 9·8, whereas in those from Celebes it is 14·4 and from 12·0 to 15·6 in those from India and Ceylon. In the length of the eggs (0·50 to 0·52 mm.) the specimens correspond most nearly with Indian specimens, the length in the latter being from 0·41 to 0·49 mm. as compared with 0·33 to 0·40 mm. in the case of those from Celebes.

Miss Rathbun, writing in 1902,[1] refers Hickson's *Atya wycki* from Celebes to the synonymy of the Japanese *C. leucosticta*, Stimpson,[2] while de Man in 1908,[3] follows other authors in regarding the form described by Hickson as a subspecies of *C. nilotica*. Three specimens of *C. leucosticta*, obtained in Japan and determined by Balss,[4] are in the Indian Museum; they almost certainly belong to the same form as those examined by Miss Rathbun and agree well enough with Stimpson's brief description. The specimens are unfortunately in very poor condition, but it seems fairly certain that they represent merely a race of *C. nilotica*. The carpi of the first legs are, however, slender—about twice as long as broad—, a fact which precludes the suggestion that they belong to *C. nilotica* subsp. *wycki*, while the comparative measurements of the dactyli of the last three legs and the very small eggs indicate affinity with the subspecies *gracilipes*.

Though the material from Japan is quite insufficient to justify any definite statement, the probability that a race of *C. nilotica* inhabits that country should not be forgotten. The Japanese form appears to be closely related to the subspecies *gracilipes* and may indeed prove to be identical with it, Stimpson's name in the latter event having priority as a subspecific term.

From the comparatively small amount of knowledge that we at present possess it

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1 Rathbun, *Proc. U.S. Nat. Mus.*, XXVI, p. 50 (1902).

2 Stimpson, *Proc. Acad. Sci. Philadelphia*, 1860, p. 28.

3 De Man, *loc. cit.*, 1908, p. 269.

4 Balss, *Abhandl. math.-phys. Klasse K. Bayer. Akad. Wiss.*, Suppl. Bd. II, Abh. 10, p. 25.

would appear that there is a discontinuity in the distribution of this form. It occurs in India and Ceylon on the one hand and in Celebes, N. China and possibly Japan on the other hand, but is apparently absent from Java, Sumatra and the Malay Peninsula. Max Weber's extensive collections of Atyidae from Java and Sumatra seem to indicate that no form of the wide-spread *C. nilotica* occurs in those islands, while, judging from Dr. Annandale's collection, the species is represented in the Malay Peninsula only by the distinct variety described below.

Caridina nilotica (Roux), subsp. **macrophora,** nov.

A subspecies of *Caridina nilotica*, readily distinguished by the very large size of its eggs from all the Asiatic races hitherto known, was found by Dr. Annandale in the

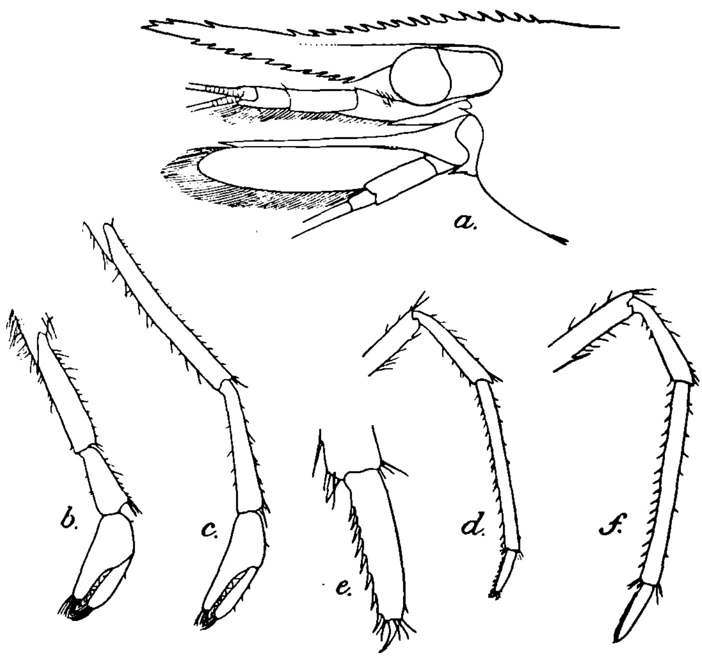

FIG. 9.—*Caridina nilotica*, subsp. *macrophora*, nov.

a. Carapace, rostrum, etc., in lateral view.
b. First peraeopod.
c. Second peraeopod.
d. Third peraeopod.
e. Dactylus of same further enlarged.
f. Fifth peraeopod.

Tale sap in Peninsular Siam. It occurred only in the inner part of the lake in water that in all probability is permanently fresh.

The rostrum (text-fig. 9*a*) usually extends a little beyond the apex of the antennal scale. In lateral view it is directed somewhat downwards in its proximal half, while distally it is a little ascendant. The proximal part of the upper margin bears a series of 13 to 20 close set teeth,[1] of which from 1 to 3 (usually 2) are situated on the carapace behind the orbital notch. The foremost of the series is, as a rule, not situated in front of the middle point of the second segment of the antennular peduncle. There are from 1 to 3 (most commonly 2) subterminal dorsal teeth and between these and the foremost of the proximal series there is, in a few cases, a single isolated tooth. The lower margin bears from 6 to 12 teeth (usually 6 to 10)[1] which decrease regularly in size from behind forwards.

The lateral process of the antennular peduncle does not reach the end of the segment to which it is attached. The antennal scale is about $3\frac{1}{2}$ times as long as broad.

In the first peraeopods (text-fig. 9*b*) the carpus is about $2\frac{1}{2}$ times as long as broad; the chela is one third longer than the carpus with the dactylus about $1\frac{1}{2}$ times the length of the palm.

The carpus of the second peraeopods (text-fig. 9*c*) is very slender, from $5\frac{1}{2}$ to 7 times as long as broad and about one fifth longer than the chela. The dactylus is $1\frac{1}{2}$ times the length of the palm.

The last three pairs of peraeopods possess the usual large spines on the lower margins of the ischium, merus and carpus. In the third pair (text-figs. 9*d*, *e*) the propodus is from $3\frac{1}{5}$ to $3\frac{1}{3}$ times the length of the dactylus (terminal spine included). Excluding the spines the latter segment is from $4\frac{1}{3}$ to nearly 5 times as long as broad: the spines vary in number from 6 to 10.

In the fifth peraeopods (text-fig. 9*f*) the propodus is from $3\frac{1}{5}$ to $3\frac{1}{2}$ times the total length of the dactylus. Excluding the spinules, which vary in number from 35 to 45, the latter segment is from $4\frac{1}{2}$ to $4\frac{3}{4}$ times as long as broad.

The outer uropod bears 8 or 9 movable spines.

The eggs are very large, from 0·90 to 0·96 mm. in length and from 0·52 to 0·58 mm. in breadth.

Large specimens do not exceed 23 mm. in total length.

Classified on the lines adopted by de Man in his excellent paper on the races of *Caridina nilotica*,[2] the form from the Tale Sap would find a place near the subspecies *gracilipes* and *bengalensis* from both of which it is immediately distinguished by the very large size of the eggs. Eggs of more than 0·75 mm. have hitherto been known

[1] In fifty specimens the numbers of rostral teeth are as follows:—

Dorsal teeth. (Not including those at apex.)	Ventral teeth.
7 specimens have 13 teeth.	5 specimens have 6 teeth.
9 ,, ,, 14 ,,	6 ,, ,, 7 ,,
11 ,, ,, 15 ,,	13 ,, ,, 8 ,,
9 ,, ,, 16 ,,	11 ,, ,, 9 ,,
5 ,, ,, 17 ,,	11 ,, ,, 10 ,,
4 ,, ,, 18 ,,	3 ,, ,, 11 ,,
4 ,, ,, 19 ,,	1 specimen has 12 ,,
1 specimen has 20 ,,	

Twenty specimens have one subtermiaal dorsal tooth, twenty-eight heve two and two have three.

[2] De Man, *Rec. Ind. Mus.*, II, p. 257 (1908).

only in two races of the species,[1] viz. the typical form, which is found in Egypt, and the subspecies *paucipara* from Natal. From both these forms the subspecies *macrophora* is distinguished by the greater proportionate length of the dactylus of the third legs, while from *paucipara* it also differs in the smaller number of spinules on the dactylus of the last leg.

C. n. macrophora may also be distinguished from all the other known races by the reduced number of teeth on the rostrum, a feature which is especially marked in the case of those on the lower border.

I have little doubt that the two mutilated specimens recorded by Lanchester[2] from the River Petwi, Tale Sap, as *Caridina wycki* are to be referred to this subspecies.

The specimens were all obtained in January, 1916, at the northern end of the Tale Sap in and near the mouth of the Patalung River. The water where they were found was quite fresh, though subject to slight alterations of level according to the state of the tide, and probably remains fresh throughout the year. The types bear the number 9664/10 in the register of the Zoological Survey of India.

Caridina brachydactyla, de Man.

1892. *Caridina wyckii*, de Man (*nec* Hickson), in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 386, pl. xxiv, figs. 29 *f, g, i, ii, k, cc, dd*.
1908. *Caridina nilotica* var. *brachydactyla*, de Man, Rec. Ind. Mus., II, p. 269.
1913. *Caridina brachydactyla*, Bouvier, *Trans. Linn. Soc., Zool.* (2), XV, pp. 463, 466.

subsp. **peninsularis**, nov.

A number of specimens collected by Dr. Annandale near Patani, in the Siamese Malay States and on Penang I. appear to represent a local race of de Man's *C. nilotica* var. *brachydactyla*. This form, hitherto known only from Celebes, Flores and Saleyer, differs notably from all other varieties of *C. nilotica* in the very short dactyli of the last three pairs of legs and Bouvier, whom I follow, has recently given it full specific rank.

Minor points of distinction are to be found between individuals from Patani and those from Penang, while the specimens from both these localities in my opinion differ sufficiently from those described by de Man to justify their separation as a distinct subspecies.

The rostrum (text-fig. 10*a*) always exceeds the length of the antennular peduncle and in some cases extends a trifle beyond the end of the antennal scale. It is a little upturned distally, more rarely straight, and is armed above with a series of 21 to 37 (usually 25 to 32) teeth of which 3 or 4 (usually 3) are situated on the carapace behind the orbital notch. In most of the specimens examined by de Man a considerable length of the rostrum towards its distal end is unarmed, except for the presence of from 1 to 3 subterminal teeth, in this respect resembling *C. nilotica*. In the specimens before me the condition is quite different. The teeth, in the great majority of cases, stretch un-

[1] The size of the eggs in *C. nilotica* subsp. *wycki*, Hickson, a race found in Lake Tondano in Celebes, is at present unknown. No ovigerous females occur among cotypes of the subspecies preserved in the Indian Museum.

[2] Lanchester, *Proc. Zool. Soc. London*, 1901, p. 560.

interruptedly from the base to the apex, with the result that it is quite impossible to draw any line of separation between the subterminal teeth and those that form the proximal series. The teeth are crowded at the base and the interspaces between them sometimes increase in size as they approach the tip. In a very few cases there is a distinct break in the series and such specimens seem to differ only in a small degree from some from Mbawa in Flores examined by de Man. He notes that in these

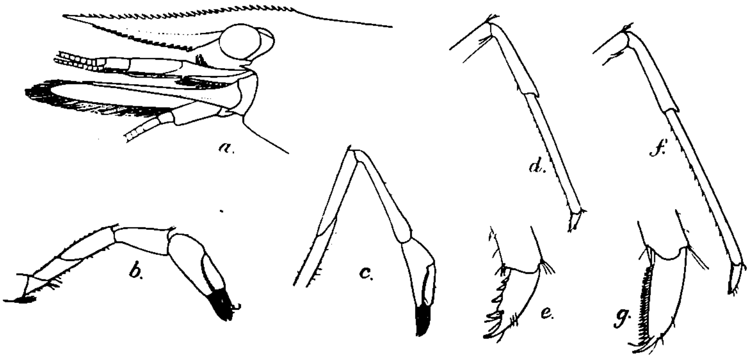

FIG. 10.—*Caridina brachydactyla*, subsp. *peninsularis*, nov.

a. Anterior part of carapace, rostrum, etc.
b. First peraeopod.
c. Second peraeopod.
d. Third peraeopod.
e. Dactylus of same further enlarged.
f. Fifth peraeopod.
g. Dactylus of same further enlarged.

examples "der distale ungezähnte Theil des oberen Randes ist kurz, nicht selten sehr kurz, zumeist ein wenig aufgebogen; vor der Spitze stehen 1-3 Zänchen, aber nicht selten rücken zwei oder drei Zänchen der proximalen Reihe mehr nach vorn und stehendann auf dem sonst gewöhnlich zahnlosen Theile" (de Man, *l.c.*, 1892, p. 393, pl. xxiv, figs. 29*i*, *ii*). The lower margin of the rostrum bears from 6 to 10 teeth in the few specimens from Patani, from 8 to 17 in those from Penang.[1] The teeth may

[1] The numbers of rostral teeth in the few specimens from Patani and in fifty examples from Penang are as follows:—

Number of dorsal teeth.	NUMBER OF SPECIMENS	
	Penang.	Patani R.
21	1	..
22	..	..
23	2	1
24	..	..
25	6	..
26	2	2
27	4	2
28	7	4
29	8	2
30	7	..
31	2	..
32	4	1
33	2	..
34	2	..
35	1	..
36	1	..
37	1	..

Number of ventral teeth.	NUMBER OF SPECIMENS	
	Penang.	Patani R.
6	..	1
7	..	..
8	3	2
9	5	5
10	10	4
11	5	..
12	5	..
13	8	..
14	7	..
15	3	..
16	3	..
17	1	..

extend throughout the anterior two-thirds of the lower border, or may cease some little distance behind the apex.

The cornea is proportionately larger than in any *C. nilotica* that I have seen, while the stalk is shorter and broader. In dorsal view the length of the cornea is greater than that of the stalk, whereas in *C. nilotica* subsp. *gracilipes* the reverse is the case.

The preocular length of the antennular peduncle is at least 0·82 times the post-ocular length of the carapace. The lateral process is short, not reaching the end of the basal segment. The antennal scale is from 3·6 to 3·8 times as long as broad; the second segment of the antennal peduncle is produced distally as a spine immediately below the insertion of the scale.

The carpus of the first peraeopods (text-fig. 10*b*) is about 2·2 times as long as broad in the Patani R. specimens, from 2·4 to 2·6 times in those from Penang. The fingers are about 1·5 times the length of the palm.[1]

In the second peraeopods (text-fig. 10*c*) the carpus is one quarter longer than the chela and is from 4·9 to 5·8 times as long as broad. The fingers are about 1·5 times the length of the palm.[1]

The last three pairs of peraeopods usually bear from 2 to 4 spines on the lower edge of the merus and, occasionally, one near the distal end of the carpus. The propodus of the third pair (text-fig. 10*d*) is from 5·6 to 6·6 times as long as the total length of the dactylus in the Patani R. specimens, from 5·5 to 5·8 (exceptionally 5·1) times in the case of those from Penang. Excluding the spines, which vary in number from 5 to 7, the dactylus (text-fig. 10*e*) is from 2·0 to 2·6 times as long as broad. In the fifth peraeopods (text-figs. 10*f*, *g*) the propodus is from 4·8 to 6·8 times the length of the dactylus; the dactylus is from 2·5 to 2·8 times as long as broad and bears from 29 to 43 (usually 36 to 43) spinules.

There are from 3 to 5 pairs of dorsal spines on the telson and from 8 to 10 at the apex. On the outer uropod there are from 12 to 14 movable spines.

The eggs vary from 0·35 to 0·42 mm. in length and from 0·22 to 0·25 mm. in breadth; they do not differ in size in specimens from the two localities.

Large specimens reach a length of about 28 mm. In examples of 18 to 20 mm. in length the rostrum is not longer than in adults whereas in varieties of *C. nilotica* it is proportionately longest in adolescent individuals.

The subspecies *peninsularis* is based solely on the character of the upper border of the rostrum; in the subspecies the teeth extend along the whole length of this border, whereas in the typical form there is an untoothed portion close behind the apex.

The few Patani specimens were obtained in the river in muddy water which was fresh though subject to tidal influence, while those from Penang came from a stream of clear water in the Botanic Gardens. In the latter locality they occurred in places where the flow of water was not very rapid and where the banks were not overgrown

[1] The length of the palm is measured from the hindmost limit of the chela to the dorsal point of junction between palm and dactylus, the dactylus from its tip to the same point. De Man appears to have measured these segments differently.

with dense jungle. They were most abundant among the roots of grasses, etc., at the edge.

The types of the subspecies, which are from Penang, bear the number 9667/10 in the register of the Zoological Survey of India.

Caridina gracilirostris, de Man.

1892. *Caridina gracilirostris*, de Man, in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.* II, p. 399, pl. xxv, fig. 31.

1904. *Caridina gracilirostris*, Roux, *Rev. Suisse Zool.*, XII, p. 555.

1905. *Caridina gracilirostris*, Bouvier, *Ann. sci. France Belgique*, XXXIX, p. 72.

1908. *Caridina* sp., de Man, *Rec. Ind. Mus.*, II, p. 227.

This species, hitherto recorded only from Celebes, Flores and Sumatra, is represented in Dr. Annandale's collection by a number of specimens from Peninsular Siam. There are also in the Indian Museum numerous examples from four widely separated parts of India. The following is a list of the localities from which specimens have been examined :—

Dhappa, near Calcutta. N. Annandale. Brackish water. Three specimens (much damaged ; recorded by de Man in 1908 as *Caridina* sp.).

Garia, near Calcutta : Dec., 1910, and Jan., 1911. S. Kemp. Brackish water. Seventeen specimens.

Sanguem R., Sanvordem, Portuguese India : Sept., 1916. S. Kemp. In water fresh at the time of capture, but subject to tidal influence. Six specimens.

Udaiyarpettai Kulam, Tinnevelly, S. India : Sept., 1911. J. R. Hill. Fresh water. Twenty-three specimens.

Tambrapani R., Tinnevelly, S. India : Sept., 1911. J. R. Hill. Fresh water. About sixty specimens.

Vellaney, Travancore : March and Sept., 1911. S. N. Pillay. Fresh water. About fifty specimens.

Patani R., below town of Patani, Siamese Malay States. N. Annandale. In water fresh at the time of capture, but subject to tidal influence.

In addition there are three specimens from Celebes, determined by de Man and received in exchange from Prof. Max Weber.

Ovigerous females were found in the months of September, December, January, February and March and occur in samples from all the localities listed above with the exception of Dhappa.

I have made a close comparison of the available material with a view to determining the possible existence of distinct races of the species. Specimens from different localities, however, agree very closely in structure and the few small differences that were observed in the case of one or two samples are of far too trivial a character to justify subspecific recognition.

The rostrum varies very considerably in length and is apparently longest in adolescent individuals between 25 and 30 mm. in length. In these it not infrequently exceeds twice the length of the carapace. In adults, especially in large females, it is usually shorter and in rare cases is less than one and a half times the length of the carapace. The dorsal teeth, excluding that at the apex, vary in number from 4 to 10 (usually 5 to 9). In the specimens from Tinnevelly the number appears to be decidedly lower than in those from other localities, while de Man has recorded examples with an exceptionally high number from the Bari R. in Flores. There is, almost without exception, a single subapical dorsal tooth: I have seen single specimens with 2 and 3 teeth in this position.

The ventral teeth of the rostrum vary still more, from 17 to 42, the majority having from 23 to 32. Here again the specimens from Tinnevelly seem to have, on the average, a lower number than the others, but the material is not sufficiently abundant for accurate determination of the point.

The numbers of teeth in specimens from the five principal localities are as follows:—

Number of dorsal teeth.	Number of specimens.				
	Garia.	Sanvordem.	Tinnevelly.	Vellaney.	Patani.
4	..	..	5	..	..
5	..	..	23	6	..
6	1	..	19	11	1
7	2	2	3	18	2
8	6	2	..	15	7
9	3	..	..	3	2
10	..	2	..	1	1

Number of ventral teeth.	Number of specimens.				
	Garia.	Sanvordem.	Tinnevelly.	Vellaney.	Patani.
17	..	..	1	..	..
19	..	..	1	..	..
20	..	..	2	..	1
21	..	..	1	..	1
22	..	..	3	1	1
23	1	..	7	3	1
24	..	..	8	1	..
25	..	1	6	5	1
26	1	..	5	3	2
27	3	1	6	4	3
28	..	..	3	11	2
29	..	..	2	6	..
30	2	2	1	1	..
31	1	..	2	3	1
32	3	..	..	4	..
33	..	..	2	..	..
34	..	..	..	3	..
35	..	1	..	1	..
36	..	..	..	1	..
37	1	..	..	..	..
38	..	..	..	1	..
41	..	1	..	1	..
42	..	..	..	..	..

The antennal scale is from $3\frac{2}{3}$ to 4 times as long as wide. The lateral process of the antennular peduncle is short, not reaching the end of the basal segment. The second segment is about twice as long as broad.

In the third maxillipedes the epipod is long and straight; the terminal segment bears from 8 to 10 spines.

The carpus of the first peraeopods is from $1\frac{2}{3}$ to 2 times as long as wide and is moderately excavate anteriorly; I have not seen any individual with this segment as slender as in de Man's examples from the Nargi River in Flores (de Man, *l.c.*, 1892, p. 403, pl. xxv, fig. 31*d*). The fingers are usually a little longer than the palm.

In the second peraeopods the carpus is from $1\frac{1}{8}$ to $1\frac{1}{3}$ times as long as the chela and is from 4 to $4\frac{1}{2}$ times as long as its greatest breadth.

The usual spines are present on the ischium, merus and carpus of the last three peraeopods. The dactylus of the third pair generally bears from 8 to 10 spines, but in specimens from the Patani River the number is higher, from 12 to 15. In the fifth peraeopods the propodus is from $3\frac{3}{4}$ (Tinnevelly) to $4\frac{1}{2}$ times (Patani R.) the length of the dactylus. The latter segment usually bears from 32 to 39 spinules; but, as in the case of the third pair, the number is higher in specimens from the Patani River, varying from 45 to 55.

The outer uropod is provided with from 8 to 11 movable spines.

Large specimens reach a total length of about 38 mm.

The size of the eggs is somewhat variable. In specimens from Calcutta, Portuguese India and the Patani River they are from 0·35 to 0·43 mm. in length and from 0·23 to 0·28 mm. in breadth. In those from Travancore and Tinnevelly they are slightly, but noticeably larger, from 0·50 to 0·52 mm. in length and from 0·32 to 0·33 mm. in breadth. The lowest of these determinations agrees with de Man's description, in which the length is stated to be $\frac{1}{3}$ mm. Even between the extremes the variation is small, but it is noteworthy that the specimens from Travancore and Tinnevelly that possess the largest eggs were found in fresh water, whereas all the rest, including those from which de Man drew up his description, were obtained in places within the reach of tidal influence.

Summarizing the foregoing observations it may be stated that material from five distinct regions (four situated in the Indian Peninsula and one in Siam) shows little signs of local variation. Three points only call for emphasis,—(i) in specimens from the Tinnevelly district in S. India the average number of upper rostral teeth is below normal, (ii) in specimens from Lower Siam the number of spines on the dactyli of the last three legs is above normal, and (iii) specimens from water that is brackish or subject to tidal influence have smaller eggs than those obtained in fresh water.

The colouration of living specimens is distinctive. The animal as a whole is translucent with the rostrum, the lower surface of the last abdominal somite, the distal two-thirds of the telson and frequently the tips of the uropods deeply pigmented. The carapace is without markings, but there is a short transverse row of chromatophores on the third abdominal somite and a longitudinal line of similar chromatophores near the inferior margin of the first five somites. The depth of pigmentation is variable. In extreme cases the whole of the rostrum, the antennules, the inner edge of the antennal scale and the tail-fan are deeply pigmented and there is a broad lateral longitudinal band on either side of the abdomen.

In my experience *C. gracilirostris* is a scarce form, much less abundant than other species of the same genus with which it is found associated.

The localities from which specimens have been examined have already been enumerated. The range of the species so far as known is Peninsular India, Lower Siam, Sumatra, Flores and Celebes.

Caridina gracillima, Lanchester.

1901. *Caridina gracillima*, Lanchester, *Proc. Zool. Soc. London*, p. 560, pl. XXXIV, fig. 1.
1905. *Caridina gracillima*, Bouvier, *Bull. sci. France Belgique*, XXXIX, p. 72.
1913. *Caridina gracillima*, Bouvier, *Trans. Linn. Soc., Zool.* (2), XV, p. 463.

As Lanchester has pointed out this form is very closely related to *C. gracilirostris*; it may indeed be no more than a well marked local race of that species. The principal distinctions between the two are as follows :—

C. gracillima, Lanchester.	*C. gracilirostris*, de Man.
Rostrum shorter, usually not more than $1\frac{1}{2}$ times length of carapace.	Rostrum longer, usually more than $1\frac{1}{2}$ times length of carapace.
Ventral teeth of rostrum less numerous, usually not more than 20.	Ventral teeth of rostrum more numerous, usually more than 20.
Outer uropod with 6 to 8 movable spinules.	Outer uropod with 8 to 11 movable spinules.
Eggs larger, from 0·65 to 0·70 mm. in length.	Eggs smaller, from 0·33 to 0·52 mm. in length.
Size smaller; total length not exceeding 25 mm.	Size larger; total length up to 38 mm.

The differences noted by Lanchester in regard to the proportionate lengths of the first two peraeopods and the spinulation of the telson break down on actual comparison of specimens.

In fifty specimens the number of dorsal teeth[1] on the proximal part of the rostrum varies from 5 to 10. In forty-nine specimens there is a single subapical dorsal tooth and in one specimen two such teeth. The ventral teeth vary from 13 to 22 (usually 14 to 20).

The antennal scale is from $3\frac{1}{2}$ to nearly 4 times as long as broad. The peraeopods agree almost precisely with those of the allied species. The dactylus of the third bears from 6 to 9 teeth and that of the fifth from 30 to 47 (52 according to Bouvier).

According to Dr. Annandale's notes living specimens were transparent, with the

[1] The teeth in these specimens are arranged thus :—

Dorsal teeth.

7	specimens have	5	teeth.
6	,,	6	,,
20	,,	7	,,
12	,,	8	,,
3	,,	9	,,
2	,,	10	,,

Ventral teeth.

1	specimen has	13	teeth.
4	specimens have	14	,,
2	,,	15	,,
15	,,	16	,,
10	,,	17	,,
9	,,	18	,,
4	,,	19	,,
2	,,	20	,,
2	,,	21	,,
1	specimen has	22	,,

rostrum, posterior and lower margins of each abdominal somite, the margins of the telson and a longitudinal streak on each branchial region dark olive green. Suffusions of the same colour were sometimes present on other parts of the body. The eggs were greenish.

The numerous specimens in the collection were all obtained in the lower reaches of the Patalung River and in the Tale Sap in Lower Siam. In the inner lake they were common in fresh water, among weeds at the mouth of the Patalung River and at the edges of the lake in the same neighbourhood. In the outer lake they were equally abundant, living among weeds round the island of Koh Yaw in water of specific gravity 1·006.

Ovigerous females were obtained in both parts of the lake, but the size of the eggs—0·65 to 0·70 mm. in length and 0·40 to 0·45 mm. in breadth—does not differ in correlation with the different specific gravity of the water. It will be noticed that the eggs of specimens obtained in slightly brackish water are nearly twice the size of those of *C. gracilirostris* living in similar situations. This fact, more than any other, has induced me to retain *C. gracillima* as a distinct species.

Lanchester was in some little doubt as to the precise locality at which his specimens were obtained. They were found by Dr. Annandale and Dr. R. Evans in 1899, when attached to the "Skeat" Expedition, and were caught in the inner lake of the Tale Sap, just inside the mouth of the Patalung River. The species has not been recorded from any other locality.

Caridina denticulata (de Haan).

1849. *Caridina denticulata*, de Haan, in Siebold's *Fauna Japonica, Crust.*, p. 186, pl. xlv, fig. 8 (as *Hippolyte*).
1894. *Caridina denticulata*, Ortmann, *Proc. Acad. Sci. Philadelphia*, p. 406.
1902. *Caridina denticulata*, Rathbun, *Proc. U.S. Nat. Mus.*, XXVI, p. 49.
1902. *Caridina denticulata*, Doflein, *Abandl. math.-phys. Klasse Bayer. Akad. Wiss. München*, XXI, p. 632, text-figs.
1905. *Caridina denticulata*, Bouvier, *Bull. sci. France Belgique*, XXXIX, p. 74.
1914. *Caridina denticulata*, Balss, *Abhandl. math.-phys. Klasse Bayer. Akad. Wiss. München*, Suppl. Bd. II, Abh. 10, p. 24.

This species has been recorded both from China and Japan and good series from each of these countries are in Dr. Annandale's collection. On comparison certain small but apparently constant differences are to be found between the two sets of specimens and I have, in consequence, given the Chinese form subspecific rank.

An important character of *C. denticulata* is the presence of an acute forwardly directed tooth on either side of the carapace at the antero-inferior angle. Though clearly shown in Doflein's figures, and less distinctly in that of de Haan, its existence is not mentioned in any of the published descriptions. The antero-inferior angle of the carapace[1] is rounded off in most known species of Atyidae, but

[1] Bouvier in his key to certain species of *Caridina* (1913) separates some forms by the presence or absence of spines at the points he calls "l'angle orbitaire" and "l'angle sous-antennaire." By the former term he apparently refers to the angle on the anterior border of the carapace which is frequently called the antennal angle or antennal spine and by

is produced to form a tooth in *C. pasadenae*, Kingsley,[1] from California and *C. davidi*, Bouvier[2] from China. A similar tooth is frequently to be found in Indian specimens of a form closely allied to *C. weberi*, subsp. *sumatrensis*; but it is here variable in its development and in some localities at least does not even possess racial significance.[3]

Classified according to the scheme outlined by Bouvier[4] in 1913, *C. denticulata* would find a place alongside the Chinese *C. davidi*, Bouvier. Balss regards the latter species as synonymous with the former, but in this he is certainly in error. *C. davidi*, co-types of which are in the Indian Museum, differs in many respects from *C. denticulata* and may be distinguished at a glance by the depressed rostrum and by the strong curvature of the propodi of the last three pairs of legs.

The Japanese and Chinese races of *C. denticulata* may be distinguished in the following manner :—

Typical form. Japan.	subsp. *sinensis*. nov. China.
Rostrum usually with 10 to 15 teeth above and with 2 to 5 below[5] (text-fig. 11*a*).	Rostrum usually with 14 to 22 teeth above and with 3 to 8 below.[6] (text-fig. 11*c*).
Anterior margin of carpus of first peraeopod slightly excavate (text-fig. 11*b*).	Anterior margin of carpus of first peraeopod deeply excavate (text-fig. 11*d*).

the latter to a projection on the infero-external aspect of the second segment of the antennal peduncle (*cf.* description of *C. brevirostris*, p. 452). He makes no mention of a tooth or spine at the antero-inferior angle of the carapace.

[1] Kingsley, *Bull. Essex Inst.*, XXVII, p. 98, pl. iii, figs. 1-7 (1897).

[2] Bouvier, *Bull. Sci. France Belgique*, XXXIX, p. 83, fig. 7.

[3] *Vide* Kemp, *Rec. Ind. Mus.*, XIV, p. 100 (1918).

[4] Bouvier, *Trans. Linn. Soc. Zool.* (2), XV, p. 462 (1913).

[5] In fifty specimens from the neighbourhood of Lake Biwa in Japan the numbers of rostral teeth are as follows :—

Dorsal teeth.	Ventral teeth.
6 specimens have 10 teeth.	1 specimen has no tooth.
4 ,, ,, 11 ,,	1 ,, ,, 1 ,,
12 ,, ,, 12 ,,	7 specimens have 2 teeth.
11 ,, ,, 13 ,,	17 ,, ,, 3 ,,
8 ,, ,, 14 ,,	16 ,, ,, 4 ,,
7 ,, ,, 15 ,,	8 ,, ,, 5 ,,
1 specimen has 16 ,,	
1 ,, ,, 17 ,,	

[6] In fifty specimens from the Tai Hu in China the numbers of teeth are as follows :—

Dorsal teeth.	Ventral teeth.
1 specimen has 12 teeth.	2 specimens have 2 teeth.
3 specimens have 13 ,,	5 ,, ,, 3 ,,
2 ,, ,, 14 ,,	13 ,, ,, 4 ,,
7 ,, ,, 15 ,,	12 ,, ,, 5 ,,
6 ,, ,, 16 ,,	9 ,, ,, 6 ,,
8 ,, ,, 17 ,,	5 ,, ,, 7 ,,
7 ,, ,, 18 ,,	3 ,, ,, 8 ,,
6 ,, ,, 19 ,,	1 specimen has 9 ,,
3 ,, ,, 20 ,,	
1 specimen has 21 ,,	
4 specimens have 22 ,,	
1 specimen has 23 ,,	
1 ,, ,, 26 ,,	

The specimens recorded by Miss Rathbun from Fusan in Korea, with 14 to 18 teeth on the upper margin of the rostrum and 4 to 6 on the lower margin, most probably belong to the subspecies *sinensis*, and this is almost certainly true of Doflein's specimens from Pekin with 14 to 16 dorsal teeth and 3 to 5 ventral. In the figure given by the latter author the deeply excavate anterior margin of the carpus of the first legs is clearly shown.

In both races the rostrum reaches almost to, or a little beyond, the apex of the antennular peduncle. Its upper border is dorsally concave with the distal quarter or third of its length unarmed. Two or three of the posterior dorsal teeth are situated on the carapace behind the level of the orbit. The preorbital length of the antennular peduncle is about seven-tenths the post-orbital length of the carapace.

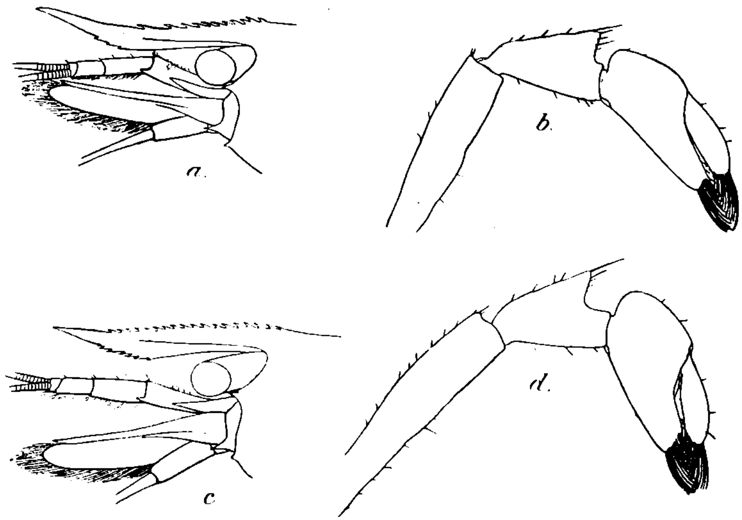

FIG 11.—*Caridina denticulata* (de Haan).
a, b. Typical form. *c, d.* Subsp. *sinensis*, nov.
a, c. Anterior part of animal in lateral view.
b, d. First peraeopod.

The merus of the third peraeopods bears 3, very rarely 4 teeth on its lower border; the dactylus bears 7 to 10 spines in Japanese specimens, 8 to 13 in those from China. The merus of the last pair of peraeopods also has 3 teeth on its lower edge; the propodus is from $2\frac{1}{2}$ to $2\frac{3}{4}$ times the length of the dactylus. The latter segment is about 4 times as long as broad; it bears about 40 to 60 teeth in Japanese specimens and about 50 to 70 in those from China. The number of movable spines on the outer uropod varies from 10 to 16.

Large specimens reach a length of about 28 mm.; none are ovigerous.

According to notes made by Dr. Annandale on Japanese specimens the species in life varies considerably in colour, as a rule it was brownish with mottled and marbled sides, with a broad pale bar running from the rostrum to the tip of the telson, and with the edges of the uropods irregularly pale. Occasionally the whole animal was dead black, except for the longitudinal mid-dorsal bar, which was then yellowish, and for the pale edging to the uropods. Chinese individuals were similarly coloured, but were as a rule rather paler.

The parasitic Temnocephalid, *Caridinicola*, was very abundant on the Chinese specimens.

The Japanese specimens were obtained at Hikone on the eastern shores of Lake Biwa and in ditches at the edge of the Seta River at its exit from the lake. The Chinese specimens were found in creeks and irrigation channels at the edge of the Tai Hu lake in Kiangsu province.

Caridina laevis, Heller.

1862. *Caridina laevis*, Heller, *Sitzber. K. Akad. Wiss. Wien*, XLV, p. 411.
1892. *Caridina laevis*, de Man, in *Weber's Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 376, pl. xxiii, fig. 27.
1905. *Caridina laevis*, Bouvier, *Bull. sci. France Belgique*, XXXIX, p. 74.
1913. *Caridina laevis*, Bouvier, *Trans. Linn. Soc., Zool.* (2), XV, p. 464.

A large number of specimens of this species have been presented to the Indian Museum by the late Dr. W. C. Hossack, who obtained them in September 1916, in Lake Situ Bagendit, Garut, Java, at an altitude of about 3000 ft. The series includes a number of ovigerous females and agrees very closely with de Man's description of specimens from the same locality. *Caridina laevis* is known only from Java.

Caridina serrata, Stimpson.

1860. *Caridina serrata*, Stimpson (not of Richters),[1] *Proc. Acad. Sci. Philadelphia*, p. 29 (98 of reprint).
1905. *Caridina serrata*, Bouvier, *Bull. sci. France Belgique*, XXXIX, p. 76.

The species does not seem to have been found since it was briefly described by Stimpson from Hong Kong more than fifty years ago. The specimens collected by Dr. Annandale are also from Hong Kong and agree fairly well with the original description.

The rostrum (text-fig. 12*a*) is very short but varies somewhat in length. In lateral view it is horizontal or inflected downwards and its apex may fall a little short of, or reach a little beyond the end of the first segment of the antennular peduncle. In dorsal view it is comparatively very broad at the base and bears above from 5 to 18 (nearly always 9 to 14)[2] small forwardly directed teeth, of which from 1 to 3 are usually situated on the carapace behind the orbit. The teeth are largest proximally and the series extends along almost the whole length of the upper border. Stimpson does not make any reference to teeth on the lower border of the rostrum, from which it might well be

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[1] *Caridina serrata*, imperfectly described by Richters as a new species in Möbius' *Meeresfauna Mauritius*, p. 163, pl. xvii, figs. 24-27 (1880), is different. Thallwitz in 1892 suggested for it the name *C. richtersii* (*Abh. Ber. K. Zool. Mus. Dresden*, 1890-91, no. 3, p. 27).

[2] In seventeen specimens, in which the rostrum is complete, the numbers of teeth are as follows:—

inferred, as has been done by Bouvier, that they were altogether absent. In the comparatively short series of specimens before me the lower margin bears from 1 to 4 very small teeth in its distal third ; it is therefore not improbable that it is occasionally toothless.

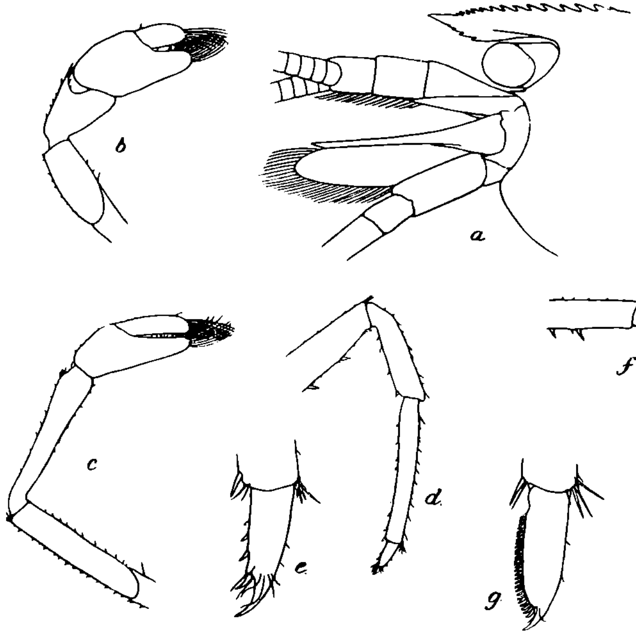

FIG. 12.—*Caridina serrata*, Stimpson.

a. Carapace, rostrum, etc., in lateral view.
b. First peraeopod.
c. Second peraeopod.
d. Third peraeopod.
e. Dactylus of same further enlarged.
f. Fifth peraeopod.
g. Dactylus of same further enlarged.

The preorbital length of the antennular peduncle is only about half the postorbital length of the carapace. The lateral process of the basal peduncular segment is long, much as in *C. serratirostris*, de Man, reaching a little beyond the end of the segment to which it is attached.

In lateral view the distal end of the second segment of the antennular peduncle is

Dorsal teeth.	Ventral teeth.
1 specimen has 5 teeth.	2 specimens have 1 tooth.
1 ,, ,, 8 ,,	4 ,, ,, 2 teeth.
3 specimens have 9 ,,	8 ,, ,, 3 ,,
2 ,, ,, 10 ,,	3 ,, ,, 4 ,,
5 ,, ,, 11 ,,	
1 specimen has 12 ,,	
2 specimens have 13 ,,	
1 specimen has 14 ,,	
1 ,, ,, 18 ,,	

produced to a tooth at its infero-external angle. The antennal scale is nearly three times as long as wide and its outer margin is very slightly concave.

The second maxillipedes are remarkable for the possession of a large protruding lobe, quadrate in outline, at the proximal end of the propodite. The third maxillipedes reach to the end of the antennal scale, the exopod extending beyond the end of the antepenultimate segment.

In the first peraeopods (text-fig. 12*b*) the carpus is equal in length with the palm and its greatest breadth is about two-thirds its extreme length; anteriorly it is very deeply hollowed to receive the rounded proximal end of the chela. The second peraeopods (text-fig. 12*c*) are long and slender, reaching a little beyond the end of the scale. The carpus is about one and a third times the length of the chela and is between $5\frac{1}{2}$ and 6 times as long as its greatest breadth. The palm is two-thirds the length of the dactylus. In the third peraeopods (text-figs. 12*d*, *e*) the merus bears four spines on its lower margin and the carpus one near its distal end. The propodus is provided with a series of spinules on the same margin; it is about 8 times as long as broad and rather more than $3\frac{1}{2}$ times as long as the dactylus (terminal spine included). The dactylus bears in all 5 or 6 spines, the outermost large and strongly curved. The fifth peraeopods (text-figs. 12*f*, *g*) bear spines on the merus, carpus and propodus, much as in the case of the third pair. The propodus is from 11 to $13\frac{1}{2}$ times as long as broad and from 4 to $4\frac{1}{2}$ times the total length of the dactylus. The latter segment bears from 29 to 34 slender spines; excluding these its length is a trifle more than three times its breadth.

The outer uropod is provided with a series of from 18 to 21 movable spinules.

Well-grown specimens reach a length of about 17 mm. The eggs are large and few in number: about 0·96 mm. by 0·70 mm. in longer and shorter diameter.

Caridina serrata is allied to *C. parvirostris*, de Man, and *C. pareparensis*, de Man, but differs from both in the much greater proportionate length of the lateral process of the antennular peduncle. In addition it differs from *C. parvirostris* in the large size of the eggs and from *C. pareparensis* in the more deeply excavate carpus of the first pair of legs. In Bouvier's latest scheme of classification (1913) it would come nearest to *C. serratirostris*, de Man, which it resembles in the length of the lateral process of the antennule. From this species, however, it differs in many respects, notably in the length and dentition of the rostrum and the form of the carpus in the first pair of legs.

Dr. Annandale informs me that, in life, the specimens were mottled with brownish pigment and were consequently very difficult to detect on the rocks on which they commonly sat. They were found in pools in very small streamlets of clear water, devoid of weeds, on the Peak at Hong Kong, at altitudes of 1200-1500 ft. The specimens were collected in September, three of the females being ovigerous. Two additional specimens from the same locality, collected by Capt. F. H. Stewart, I.M.S., have recently been presented to the Museum.

Stimpson gives the habitat of his specimens as "ad insulam Hong Kong; in rivulis."

Caridina weberi, de Man.
subsp. **sumatrensis,** de Man.

1892. *Caridina weberi* var. *sumatrensis*, de Man, in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 375, pl. xxii, fig. 23 *g*.

1905. *Caridina weberi* var. *sumatrensis*, Bouvier, *Bull. sci. France Belgique*, XXXIX, pp. 75, 83.

The principal characters of the specimens that I refer to this subspecies are as follows :—

The rostrum reaches nearly to, or a little beyond the end of the second segment of the antennular peduncle and is armed above with from 12 to 21 (usually 15 to 19)[1] teeth of which from 4 to 6 (usually 4 or 5) are situated on the carapace behind the orbital notch. The lower margin bears from 2 to 9 teeth (usually 3 to 6).

The lateral process of the antennular peduncle does not nearly reach the end of the basal segment. The longitudinal carina on the dorsal surface of the antennulary somite is high. The antero-inferior angle of the carapace is rounded.

The carpus of the first peraeopods is deeply excavate anteriorly and is from 1·8 to as 2·0 times as long as its greatest breadth. In the second pair the carpus is very slender, 6·7 or 6·8 times as long as broad. The propodus of the third peraeopods is from 4·3 to 4·7 times the length of the dactylus, the latter segment bearing 7 spines. In the fifth legs the propodus is 5·2 times as long as the dactylus (4·5 times in a very large individual) ; the spinules on the dactylus vary in number from 36 to 57. The outer uropods bear 18 or 19 movable spines.

Fully developed eggs are from 0·46 to 0·47 mm. in length and from 0·28 to 0·29 mm. in breadth. An exceptionally large specimen is about 24 mm. in total length.

The specimens are from Penang I. and the lower reaches of the Patani River ; in both localities they were found together with the examples of *C. brachydactyla* subsp. *peninsularis*. There are thirty-one specimens from Penang and two from the Patani River.

The subspecies *sumatrensis* was described from Sumatra and has also been recorded from Bombay.

Genus **Paratya,** Miers.

1882. *Paratya*, Miers, *Ann. Mag. Nat. Hist.* (5), IX, p. 194.

1909. *Xiphocaridina*, Bouvier, *Comptes Rendus Acad. Sci. Paris*, p. 1729.

1917. *Paratya*, Kemp, *Rec. Ind. Mus.*, XIII, p. 293.

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[1] In thirty specimens (from Penang) the numbers of teeth as are follows :—

Dorsal teeth.	Ventral teeth.
1 specimen has 13 teeth.	3 specimens have 2 teeth.
4 specimens have 15 ,,	7 ,, ,, 3 ,,
8 ,, ,, 16 ,,	6 ,, ,, 4 ,,
6 ,, ,, 17 ,,	7 ,, ,, 5 ,,
5 ,, ,, 18 ,,	4 ,, ,, 6 ,,
3 ,, ,, 19 ,,	2 ,, ,, 7 ,,
2 ,, ,, 20 ,,	1 specimen has 9 ,,
1 specimen has 21 ,,	

I have recently given some notes on the species and races of this genus and have pointed out that the form inhabiting Australia is not, as was hitherto supposed, conspecific with that found in Japan. The information I have been able to give regarding the two races found in the latter country is, in the main, derived from material obtained by Dr. Annandale.

Paratya compressa (de Haan).

1917. *Paratya compressa*, Kemp, *Rec. Ind. Mus.*, XIII, p. 296, text-figs. 1 *a-f*.

The typical form of this species was found in abundance by Dr. Annandale among weeds and dense vegetation at Komatsu and in pools and backwaters round Lake Biwa; in the lake itself it was much scarcer. Other specimens are from Ogura and Yodo ponds near Kyoto. The Temnocephaloid worm *Caridinicola* was present in the gill-chambers of a large proportion of the individuals examined at Komatsu.

subsp. **improvisa**, Kemp.

1917. *Paratya compressa*, subsp. *improvisa*, Kemp, *Rec. Ind. Mus.*, XIII, p. 299, text-figs. 2 *a-f*, 3.

The race differs from the typical form in certain well-defined rostral characters. Judging from the material examined it is restricted to the north-eastern parts of the main island, while the typical form inhabits the south-western regions. The boundary between the two races appears to be just to the north-east of Lake Biwa.

The specimens I have examined are from the lagoon Kasumi-ga-ura in Hikachi province, collected by Dr. Annandale; from Tokio, collected by Hilgendorf (Berlin Mus.); from Lake Haruna, near Ikao, about 3000 ft., collected by Dr. K. Nakazawa and from Lake Suwa, in the Shinano province, 2660 ft., collected by Dr. T. Kawamura.

Tribe **PENAEIDEA.**

Family PENAEIDAE.

Subfamily *PENAEINAE.*

Penaeus indicus, Milne-Edwards.

var. **merguiensis**, de Man.

1906. *Peneus indicus* var. *merguiensis*, Alcock, *Cat. Indian Decap. Crust.*, III, i, p. 13, pl. ii, fig. 4.

1911. *Penaeus merguiensis*, de Man, *Decap. 'Siboga' Exped., Penaeidae*, p. 104, and (1913), pl. ix, figs. 33 *a-c*.

Two specimens obtained by Dr. Annandale in Lower Siam are referred with some doubt to this form. The principal distinction between typical *indicus* and the variety *merguiensis* rests in the comparative length of the terminal segment of the third maxillipede of the male, and both the specimens in the collection are female.

In the larger individual, which is about 120 mm. in length, the rostrum is much elevated at the base, as in Alcock's figure, and the foremost tooth on the upper border is situated above the middle of the terminal segment of the antennular peduncle. In the smaller example, which is 85 mm. in length, the rostrum agrees precisely with de Man's fig. 33*a*.

The large specimen was taken from fishermen's nets opposite Singgora in the outer lake of the Tale Sap; the smaller individual is from Patani Bay, at the mouth of the Patani river in the Siamese Malay States.

Penaeus carinatus, Dana.

1906. *Peneus semisulcatus*, Alcock (not of de Haan), *Cat. Indian Decap. Crust.*, III, i, p. 10, pl. i, fig. 2.

1911. *Penaeus carinatus*, de Man, *Decap. 'Siboga' Exped., Penaeidae*, p. 101.

1915. *Penaeus carinatus*, Kemp, *Mem. Ind. Mus.*, V, p. 317.

Two males and one female, varying in length from 176 to 186 mm., are in Dr. Annandale's collection. They were obtained from nets and stakes set by fishermen opposite Singgora in the outer part of the Tale Sap in Lower Siam.

Genus **Penaeopsis**, Bate.

Penaeopsis monoceros (Fabricius).

1906. *Metapeneus monoceros*, Alcock, *Cat. Indian Decap. Crust.*, III, i, p. 18, pl. iii, figs. 7, 7*a–c*.

1911. *Penaeopsis monoceros*, de Man, *Decap. 'Siboga' Exped., Penaeidae*, p. 55 and (1913), pl. vi, figs. 14*a–c*.

Numerous examples of both sexes, the largest 107 mm. in length, were found by Dr. Annandale in the Tale Sap, along with the preceding species. The petasma does not appear to be fully developed in any of the specimens.

Penaeopsis affinis (Milne-Edwards).

1906. *Metapeneus affinis*, Alcock, *Cat. Indian Decap. Crust.*, III, i, p. 20, pl. iii, figs. 8, 8*a–d*.

1911. *Penaeopsis affinis*, de Man, *Decap. 'Siboga' Exped., Penaeidae*, p. 57 and (1913), pl. vi, figs. 15 *a*, *b*.

Nine males were found in company with *P. monoceros*. All are young, the largest being only 78 mm. in length. The fifth legs are not appreciably longer than in *P. monoceros* of similar size, and in no case reach beyond the end of the second segment of the antennular peduncle. The petasma precisely resembles that figured by de Man and differs conspicuously from that of the larger specimens recorded from the Chilka Lake [1] and from Alcock's figure. The differences, as de Man has noted, are probably due to age.

Penaeopsis brevicornis (Milne-Edwards).

1906. *Metapeneus brevicornis*, Alcock, *Cat. Indian Decap. Crust.*, III, i, p. 22, pl. iv, figs. 10, 10 *a*, *b*.

The collection contains two large females from the Tale Sap, found with *P. monoceros*, and one male and four females from Patani Bay, at the mouth of the Patani

[1] Kemp, *Mem. Ind. Mus.*, V, p. 321 (1915).

river in the Siamese Malay States. The females are from 76 to 117 mm. in length and the male 73 mm.

In both sexes the rostrum is more elevated at the base than in Alcock's figure; in the male it reaches only a little beyond the eyes, whereas in the female it is much longer, extending to or a trifle beyond the end of the antennular peduncle. Alcock has not noted any difference between the sexes in the proportionate length of the rostrum, but some of the females determined by him are in close agreement with those in the present collection. The petasma agrees almost exactly with Alcock's figure. The thelycum varies considerably, more especially as regards the size of the central plate between the bases of the fourth legs.

Family SERGESTIDAE.

Genus **Acetes**, Milne-Edwards.

The characters of the different species of *Acetes* have hitherto been very imperfectly known, and the determination of the three forms in the collection proved in consequence to be a matter of some difficulty. It was only after an examination of the long series of undetermined specimens in the Indian Museum that definite conclusions were reached. The results of my examination of this material (with which that collected by Dr. Annandale is included) have been published in the *Records of the Indian Museum*. In this paper Milne-Edwards' *A. indicus* is redescribed and figured along with *A. erythraeus*, Nobili, *A. japonicus*, Kishinouye, and a hitherto unknown form from Borneo. In three of the species well marked sexual differences are to be found in the length of the last segment of the antennular peduncle. In the fourth species, *A. erythraeus*, Nobili, the males appear to be dimorphic in respect of the proportionate length of this segment, the specimens on which this interesting observation is based forming part of Dr. Annandale's collection.

Acetes indicus, Milne-Edwards.

1917. *Acetes indicus*, Kemp, *Rec. Ind. Mus.*, XIII, p. 47, text-figs.

The specimens in Dr. Annandale's collection are from the Tale Sap. Eleven examples were obtained in the channel between the inner and outer lakes in the vicinity of Pak Raw and Pak Payun, the specific gravity of the water varying from 1·0015 to 1·00225 (corrected). Four individuals were also found at the mouth of the outer lake near Singgora in company with *Acetes japonicus*, the specific gravity of the water here varying from 1·004 to 1·0085.

Acetes erythraeus, Nobili.

1917. *Acetes erythraeus*, Kemp, *Rec. Ind. Mus.*, XIII, p. 51, text-figs.

This species is represented in the collection by four males from the mouth of the Prai river, opposite Penang and by a few of each sex from the Patani river, below the town of Patani in the Siamese Malay States. In the latter locality the species was found with *Acetes japonicus*, occurring in water that was quite fresh, though in a situation subject to tidal influence.

In the paper cited above I have drawn particular attention to the four individuals from the Prai river, for it is on their characters that I have based my statement that the male in this species is dimorphic. In all the four specimens (precisely as in males of *A. indicus* and *A. erythraeus*) the ultimate segment of the antennular peduncle is slender and longer than the basal segment. In examples of the same sex from the Patan river, as well as in numerous males from three separate localities on the west coast of the Bay of Bengal, the ultimate peduncular segment is invariably short, closely resembling that of the female[1]: the specific identity of the Prai river specimens is proved beyond doubt by the distinctive form of the petasma.

Acetes japonicus, Kishinouye.

1917. *Acetes japonicus*, Kemp. *Rec. Ind. Mus.*, XIII, p. 56, text-figs.

The collection contains numerous specimens obtained in the market at Osaka in Japan, a considerable number from the Tale Sap and a few from the Patani river in the Siamese Malay States. The examples from the Tale Sap were found along with a few *A. indicus* at the mouth of the outer lake near Singgora in water of specific gravity varying from 1·004 to 1·0085 (corrected). Those from the Patani river were taken in company with *A. erythraeus* in water that was fresh at the time of their capture but subject to tidal influence.

Genus **Lucifer**, Thompson.

Lucifer hanseni, Nobili.

1906. *Lucifer hanseni*, Nobili, *Ann. Sci. nat., Zool.* (9), IV, p. 25, pl. ii, fig. 1 and text-fig. 3*b*, p. 27.

1915. *Lucifer hanseni*, Kemp, *Mem. Ind. Mus.*, V, p. 324, text-figs. 37*a–d*.

1916. *Leucifer hanseni*, Borradaile, *Brit. Antarct. Exped.*, '*Terra Nova*,' *Zool.*, III, p. 83.

A number of specimens were obtained in the outer lake of the Tale Sap, between Koh Yaw and the mainland and at the mouth of the lake near Singgora. The specific gravity of the water in which they were found varied from 1·00625 to 1·0085 (corrected).

Lucifer hanseni was described by Nobili from the Red Sea and has recently been recorded by Borradaile from Melbourne.

STOMATOPODA.

Family SQUILLIDAE.

Genus **Squilla**, Fabricius.

Four species and one variety of Stomatopoda, all belonging to the genus *Squilla*, were found by Dr. Annandale at the mouth of the Tale Sap in Peninsular Siam. They were obtained in fishermen's nets and all were caught in water of specific gravity 1·0085 (corrected).

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[1] I have recently examined a large male of *A. erythraeus* from Silavathurai Lagoon, near Tuticorin, S. India, which agrees exactly with the specimens from the Prai River. This is the first record of the "high" dimorphic male from the coasts of British India. We are indebted to Mr. J. Hornell for the specimen.

Squilla scorpio, Latreille.

1913. *Squilla scorpio*, Kemp, *Mem. Ind. Mus.*, IV, p. 42, pl. ii, fig. 30.

Five specimens are in the collection, the largest a male 75 mm. in length. Apart from the fact that the lateral carinae of the fourth abdominal somite occasionally terminate in spines, the specimens agree exactly with the description in the paper quoted above.

var. **immaculata,** Kemp.

1913. *Squilla scorpio* var. *immaculata*, Kemp, *loc. cit.*, p. 45, pl. ii, fig. 31.

Six specimens, the largest a male 73 mm. in length, were obtained in company with typical *scorpio*. As in the case of the collection from the Chilka Lake,[1] where both forms also occur, no specimen with intermediate characters is to be found. The variety *immaculata* has hitherto not been recorded east of the Bay of Bengal.

Squilla nepa, Latreille (Bigelow).

1913. *Squilla nepa*, Kemp, *loc. cit.*, p. 60, pl. iv, fig. 49.

Two specimens were obtained, the largest a male 70 mm. in length. *S. nepa* has not hitherto been reported from brackish water.

Squilla interrupta, Kemp.

1913. *Squilla interrupta*, Kemp, *loc. cit.*, p. 72, pl. v, figs. 60–62.

A number of young specimens were obtained, the largest only 46 mm. in length. In very small individuals the tubercles on the upper edge of the carpus are represented only by two obscure lobes. This species also was not previously known to inhabit brackish water.

Squilla raphidea, Fabricius.

1913. *Squilla raphidea*, Kemp, *loc. cit.*, p. 88, pl. vii, fig. 77.

Two specimens were obtained, a female 255 mm. in length and a male 200 mm. in length. The latter individual differs from the majority of large examples of the same sex, preserved in the Indian Museum, in the complete absence of the angular projection on the external border of the dactylus of the raptorial claw. In the paper cited above attention is drawn to the existence of the same phenomenon in a male 190 mm. in length. *S. raphidea* has not hitherto been recorded from brackish water.

ADDENDUM.

While this paper was in the press I received from Soochow, through the kindness of Prof. N. Gist Gee, some further specimens of *Palaemonetes sinensis* (see p. 272). The largest of these individuals is 40 mm. in length, whereas none of those collected by Dr. Annandale exceed 25 mm. Some of the Soochow specimens are ovigerous, bearing eggs about 1·2 × 0·94 mm. in longer and shorter diameter.

[1] Kemp, *Mem. Ind. Mus.*, V, p. 193 (1915).

Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

MOLLUSCA OF THE TAI-HU

By N. Annandale, *D.Sc.*, *F.A.S.B.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

THE MOLLUSCA OF THE TAI-HU IN THE KIANGSU PROVINCE OF CHINA.

By N. ANNANDALE, *D.Sc.*, *F.A.S.B.* (*Zoological Survey of India*).

(Plate X.)

INTRODUCTION.

The Tai-Hu or Great Lake (see map on p. 4 of this volume) is a large body of fresh water occupying a shallow depression in the alluvium of the Yangtse delta. It is probably nowhere more than 12 feet deep. Its bottom is muddy and its water turbid. The shores are low and shelving and at some places there are beds of small stones at the margin. Outcrops of limestone form islands in the lake. It is said that the water never freezes; but the temperature sinks almost to freezing point in winter, while in summer it is probably high. Except in narrow channels between the islands and in the creeks through which various waterways enter the lake, there are few water-weeds. In these such plants as *Potamogeton*, *Myriophyllum* and *Vallisnieria* are abundant.

The lake is perhaps as unlike Lake Biwa in Japan as any lake situated in the same region and in similar latitudes could be. It is not surprising, therefore, that the molluscan fauna differs greatly both in general facies and in composition. From Lake Biwa, the molluscs of which have already been discussed in this volume, we know of 16 species of Gastropoda and of 19 species of Lamellibranchiata, 35 species in all. In the few days at our disposal Dr. Kawamura and I were able to examine only one corner of the Tai-Hu, which covers an area of over 3,000 square miles, but that corner was pretty thoroughly explored so far as the Mollusca were concerned and there is no reason to think that conditions differ greatly in other parts of the lake. Our collection, therefore, may be regarded as characteristic if not exhaustive. Specimens of 11 species of Gastropoda and 6 species of Lamellibranchiata, 17 in all, were obtained. The following is a list of the species. Curiously enough Heude in his works on the Yangtse Mollusca does not refer to the Tai-Hu, and I have been unable to discover any other reference to its fauna.

LIST OF THE AQUATIC MOLLUSCA OF THE TAI-HU.

GASTROPODA.

Family Limnaeidae.

Limnaea clessini, Neumayr.

Planorbis saigonensis, Crosse and Fischer.

Family Melaniidae.

Melania cancellata, Benson.

Family Hydrobiidae.

Bithynia striatula, Benson.

Bithynia longicornis, Benson.
Hypsobia minuscula, sp. nov.
Stenothyra decapitata, sp. nov.
Pseudovivipara hypocrites, gen. et sp. nov.

Family Assimineidae.
Assiminea scalaris, Heude.

Family Viviparidae.
Vivipara lapillorum (Heude).
Vivipara catayensis (Heude).

LAMELLIBRANCHIATA.

Family Mytilidae.
Modiola lacustris, von Martens.

Family Unionidae.
Anodonta woodiana (Lea).
Nodularia dactylina (Heude).
Nodularia douglasiae (Griff).

Family Cyrenidae.
Corbicula sandai, Rein.
Sphaerium, sp.

It is not possible, except to a very limited extent, to distribute these molluscs into zones of life as was done with the molluscs of Lake Biwa, mainly because conditions are much more uniform throughout the lake. One species (*Assiminea scalaris*) is quasi-aquatic rather than aquatic, while four (*Vivipara lapillorum, Bithynia striatula, Bithynia longicornis* and *Modiola lacustris*) are found chiefly near the margin among small stones or on the roots of trees. The two species of *Bithynia* and the *Vivipara* are also found in canals in the neighbourhood. Only three species appear to be definitely lacustrine, occurring in large numbers on the bed of the lake. They are *Stenothyra decapitata, Hypsobia minuscula* and *Corbicula sandai*. The other species were found chiefly in narrow creeks and channels and all of them probably occur also in canals and waterways.

Considered as a whole the Molluscan fauna of the lake possesses two outstanding peculiarities:—(1) the small size of its members and (2) the estuarine element in its composition.

Some of the gastropods, if they are not actually peculiar to the Tai-Hu, are probably small wherever they occur, for example the *Stenothyra*, the *Hypsobia* and *Assiminea scalaris*, which has also been found in other localities in the same district. At least five species (*Bithynia longicornis, Vivipara lapillorum, Modiola lacustris, Anodonta woodiana* and *Corbicula sandai*) are smaller in the lake than they are in more favourable localities. There is, moreover, a scarcity in the lake-fauna of the large Viviparidae of the *Vivipara chinensis* group, which are characteristic of the aquatic fauna of the Yangtse valley as a whole, but perhaps mainly paludine. Still more characteristic of the latter fauna are the gigantic Unionidae (*e.g. Cristaria herculea*) not uncommon in some parts of the Yangtse delta. No trace of any such species was found in the lake. It is clear, therefore, that in the Tai-Hu conditions do not favour the attainment of large size among the molluscs, though this character is a feature of the more extended fauna of which that of the lake forms a small section. Our knowledge of the conditions of life in different parts of the Yangtse system is still rudimentary, but among the unfavourable factors present in the Tai-Hu it is probable that we must reckon the muddiness of the water, its shallowness (which prevents the fauna from seeking shelter from extremes of temperature in the depths) and the scarcity of food due to poverty of vegetation. Another factor that may be considered is that of overcrowding. I have noticed in India that in ponds in which a few species are present in great abundance the individuals of these species are often dwarfed, even when individuals of other species more sparingly represented attain a normal size. It is noteworthy, therefore, that almost all the Tai-Hu molluscs except the large *Vivipara* are extremely abundant in the lake. We do not yet know, however, whether overcrowding acts directly on the individual through the products of metabolism, or whether it does not rather imply an intensive reproduction due to other unfavourable circumstances such as scarcity of food or oxygen.

It may further be noted here that one species (*Pseudovivipara hypocrites*) is blind, while another (*Hypsobia minuscula*) has very small eyes — facts probably correlated with the muddy water in which they live.

The estuarine element in the Tai-Hu fauna, an element by no means confined to the Mollusca, is represented among the Gastropoda by species of the genera *Stenothyra* and *Assiminea* and among the bivalves by a species of *Modiola*. It is probable that all these species make their way much higher up the river-system, but only the *Modiola* is known to do so. In India *Stenothyra*, *Assiminea* and *Modiola* are all characteristic of the upper estuaries of the larger rivers, but I do not know of any species that has established itself in permanently fresh water. *A. francesiae*, Gray, which resembles *A. scalaris* in its quasi-aquatic habits, has made its way up the Hughli at least as far as tidal limits, that is to say for over a hundred miles from the open sea, and is common not only on the banks of the river but also in flooded fields in the vicinity, but I have never seen any species of either *Stenothyra* or *Modiola*, both of which are strictly aquatic, further inland than Calcutta, in the neighbourhood of which there is much brackish water. The Tai-Hu is not so far inland as Calcutta, but it is not connected with any tidal water-way. Its water, moreover, is not liable to admixture of salt, for the fresh water that pours down in such vast quantities through the mouths of the Yangtse has more influence in counteracting the tides than that of any of the Gangetic effluents and brackish water apparently extends inland for a much shorter distance in the Chinese than in the Indian delta; indeed, at the mouth of the Yangste practically fresh water extends for a considerable distance out to sea.

We know as yet very little about the estuarine fauna of China, but the occurrence in the Tai-Hu of estuarine species and genera proves at any rate that the well-known estuarine element present in the fluviatile fauna of the Ganges has its parallel in China.

The molluscs of the Tai-Hu do not cast much light of a geographical nature on the aquatic fauna of China. The genus *Hypsobia* has, however, some interest from this point of view. It was hitherto known from two species, *H. humida* from the Upper Yangtse and *H. nosophora* from an inland district of the Main Island of Japan, but these species have been placed in separate genera and have peculiar habits, being only quasi-aquatic. The discovery of a third, completely aquatic species (*H. minuscula*) in the Yangtse delta, therefore, provides a record of intermediate locality for the genus. The new Hydrobiid genus *Pseudovivipara* probably occurs in Hainan as well as in the Yangste valley. This genus has a remarkable but perhaps superficial resemblance to certain forms (*Tylopoma*) from the later Tertiary of eastern Europe and usually assigned to the Viviparidae.

Systematic Description of the Collection.

GASTROPODA.

Family LIMNAEIDAE.

This family is represented in our collection from the Tai-Hu by two species only, one of *Limnaea* and one of *Planorbis*. The latter belongs to the section *Gyraulus*.

Genus **Limnaea**, Draparnaud.

Limnaea clessini, Neumayr.

1887. *Limnaeus clessini*, Neumayr, *Süssw.-Moll.*, *in Wiss. Ergebn. Reise Béla Széchenyi*, II. p. 657, pl. iv, figs. 4-5.

Specimens from the Tai-Hu and Soochow agree in every respect with Neumayr's fig. 5.

The species is common among weeds in the Tai-Hu and in canals at Soochow. It was described from the southern limits of the Gobi desert.

Genus **Planorbis**, Guettard.

Planorbis saigonensis, Crosse & Fischer.

1863. *Planorbis saigonensis*, Crosse and Fischer, *Journ. Conch.*, XI, p. 362, pl. xiii, fig. 7.
1866. *Planorbis saigonensis*, Clessin, *Limnaeiden* in Chemnitz's *Conch.-Cab.*, ed. Küster, p. 191, pl. xxix, fig. 3.
1909. *Planorbis saigonensis*, Germain, *Rec. Ind. Mus.*, III, p. 117.

Shells from the Tai-Hu agree well with Crosse and Fischer's original description and figures except that they have a yellowish tinge and are translucent. They are not more than 5 mm. in diameter. The original figure seems to have been drawn from a dead shell.

We found the species in considerable abundance on the lower surface of stones at the edge of the Tai-Hu and among weeds in a canal at Soochow. It has a very wide geographical range, which extends, according to Germain, not only over a great part of continental Asia but also to Japan and the Malay Archipelago. It is one of our commonest freshwater molluscs in India, while it has been generally known under the name *P. compressus*. For the synonomy see Germain, *op. cit.*, p. 117.

Family MELANIIDAE.

Genus **Melania**, Lamarck.

Melania cancellata, Benson.

1842. *Melania cancellata*, Benson, *Ann. Mag. Nat Hist.*, IX, p. 498.
1856. *Melania ningpoensis*, Lea, *Proc. Ac. Nat. Sci. Philadelphia*, VIII, p. 144.
1882. *Melania cancellata*, Heude, *Mem. Hist. Nat. Emp. Chinois*, I, *Moll. d'Eau douce*, p. 167, pl. xli, fig. 31, pl. xliii, figs. 3, 4.

The body-whorl is relatively larger and the spire tapers less evenly in shells from the Tai-Hu than in topotypes of Benson's species from Cantor's collection. In this respect my specimens agree with topotypes of *M. ningpoensis*, Lea. It is clear, however, from the collection in the Indian Museum that the species is a plastic one. The measurements in millimetres of three normal shells from the neighbourhood of the Tai-Hu are as follows. In all the tip is eroded :—

Length.	Breadth.	Aperture.
22·5	8·5	7·25 × 3·5
20·5	6·25	5·75 × 3·3
16·75	6·25	5 × 3·5

The first two specimens are from the lake, the last from a canal at Soochow. In the latter locality the shells are smaller and less eroded and have the body-whorl more inflated than those from the Tai-Hu.

Heude (*op. cit.*, pl. xliii) has published Rathouis's figures of the radula and of various points in the anatomy.

The species is common in all parts of the lake, both among stones at the margin and on a muddy bottom in 3 metres. According to Heude it and his *M. erythrozona*, which is perhaps no more than a phase of the widely distributed *M. tuberculata* (Müller), are the only two real lacustrine *Melaniae* found in China. *M. cancellata* occurs in the watersheds of the Yangtse, the Hoangho and the Amur.

Family HYDROBIIDAE.

This family is represented in the Tai-Hu fauna by five species, two of which (*Bithynia striatula* and *B. longicornis*) are common and widely distributed in China. The other three, two of which are minute forms, have not hitherto been described. One of these belongs to the interesting genus *Hypsobia*, Heude, another to *Stenothyra*, Benson, and the third to a genus hitherto undescribed. The last is remarkable not only for its large size, but also for the extraordinary resemblance of the shell to that of *Vivipara*.

Genus **Bithynia**, Gray.

Bithynia striatula, Benson.

1842. *Paludina (Bithynia) striatula*, Benson, *Ann. Mag. Nat. Hist.*, IX, p. 488.
1855. *Paludina (Bithynia) striatula*, *id.*, *Journ. As. Soc. Bengal*, XXIV, p. 131.
1882. *Bithynia chinensis* and *spiralis*, Heude, *op. cit.*, pp. 171, 172, pl. xlii, figs. 8, 8*a*, 9, 9*a*.
1901. *Bithynia striatula*, Pilsbry, *Proc. Ac. Nat. Sci. Philadelphia*, LIII, p. 405.

Pilsbry (*op. cit.*) has discussed the synonymy of this species. I have examined specimens from the following localities:—Canton, Swatow, Chusan, Soochow, the Tai-Hu and Peking in China, Mukden in Manchuria and Lake Biwa in Japan. The specimens from Chusan are from Cantor's collection and were named by Benson. They may be regarded, therefore, as co-types of the species. Except those from Japan, which belong to Pilsbry's race *japonica*, the shells in this large series are fairly uniform, differing mainly in colour (from pale olivaceous to dark reddish) and size. They vary also in the prominence of the spiral ridges, not altogether in correlation with environment.

There is, further, a certain difference in shape, some being more elongate than others, but this difference is perhaps sexual and cannot be correlated with locality. The specimens from Mukden are the largest and agree well with Heude's figures of his *B. chinensis*.

B. striatula is not uncommon among stones at the edge of the Tai-Hu. It also occurs in canals at Soochow.

Bythinia longicornis, Benson.

1842. *Paludina* (*Bithynia*) *longicornis*, Benson, *op. cit.*, p. 488.
1855. *Paludina* (*Bithynia*) *longicornis*, *id.*, *op. cit.*, p. 130.
1882. *Bithynia longicornis*, Heude, *op. cit.*, p. 171, pl. xlii, figs. 4, 4*a-b*.

There are three co-types of Benson's species in the collection of the Zoological Survey of India and I have recently examined a number of specimens from Suigen in Corea (*T. Kawamura*) which agree closely with them. Specimens taken with those of *Bithynia striatula* in the Tai-Hu and at Soochow differ from the co-types in being considerably smaller (not more than 7 mm. long by 5 mm. broad) and in having their apices eroded, but are otherwise similar. The species is abundant in the Tai-Hu district, and is stated by Heude to be "banale dans les eaux lacustres de toute le vallée du Yang-tze qu'elle suffirait pour characteriser paleontologiquement, si le sol pouvait la conserver."

Genus **Hypsobia**, Heude

1882. *Hypsobia*, Heude, *op. cit.*, p. 173.
1915. *Katayama*, Robson, *Brit. Med. Journ.*, No. 2822, p. 203.

I cannot discover any difference between Heude's *Hypsobia* and Robson's *Katayama*. The structure of these molluscs is unusually well known, for Heude figures the radula and operculum and reproduces certain details of the soft parts, while Robson gives sketches of the radula and operculum.

Type-species.—*Hypsobia humida*, Heude and Rathouis.

Geographical Distribution. The valley of the Yangtse and parts of the Main Island of Japan. Including a new species to be described here, three species are known, namely *H. humida* found "*in alto districtu Tchen-k'eou*" in the upper Yangtse watershed, *H. minuscula*, sp. nov. from the Tai-Hu and *H. nosophora* from the Bingo province of Japan.

H. humida and *H. nosophora* are found in damp places, the latter at the edge of water-channels and other small bodies of water, while my new species was dredged from the bottom of the lake. *H. nosophora* appears to be the main if not the only carrier of Schistosomiasis[1] in Japan. It is fortunately very local in distribution. Both it and *H. minuscula* are markedly gregarious.

Key to the known species of *Hypsobia*.

1. Shell more than 7 mm. long, of a brownish colour, with the aperture ovoid, not much longer than broad; irregular growth-lines crossing the finely granular surface, a faint microscopic spiral sculpture .. *H. nosophora*.

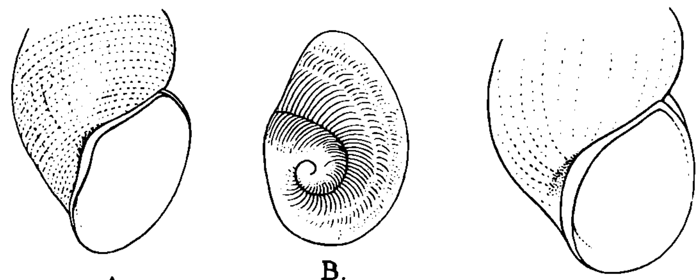
[1] See Katsurada, *Annot. Zool. Japon*, V, p. 147 (1904) and Leiper *Brit. Med. Journ.*, No. 2822, p. 202 (1915). *H. nosophora* is known in Japan as *Blanfordii nosophora*, Pilslong (or Robson). See *Journ. Parasitology* III, No. 4, Notes (1917).

2. Shell about 4 mm. long, pale horny, nearly smooth; aperture pyriform, considerably longer than broad .. .. .. *H. humida.*
3. Shell less than 3 mm. long, transparent, colourless, ornamented with minute serrated spiral ridges interrupted by longitudinal striae; aperture oval, considerably longer than broad .. .. *H. minuscula.*

I have not seen *H. humida* but have examined a series of shells of *H. nosophora.*

Hypsobia minuscula, sp. nov.

Shell minute and fragile, colourless, transparent, shining, slightly iridescent, hardly subumbilicate, probaby with seven whorls when complete, but always eroded at the tip. Whorls increasing gradually, somewhat inflated; body-whorl not markedly projecting; suture impressed, not markedly oblique. Sculpture consisting of numerous minute serrated spiral ridges interrupted at frequent and irregular intervals by oblique longitudinal striae in such a way as to give the surface a reticulate appearance under a high power of the microscope. Aperture oval, oblique, relatively large,



A. B. C.

FIG. 1.

A. Mouth of shell of *Hypsobia minuscula*, sp. nov. (Highly magnified).
B. External view of operculum of same species. (Still more highly magnified).
C. Mouth of shell of *Hypsobia nosophora* (Robson). (Less highly magnified).

with its anterior extremity not at all pointed. Outer lip sometimes slightly introverted in the middle; columellar lip delicately expanded and rimate. Columella strongly arched. Operculum like that of *H. humida* and *H. nosophora* but broader, hyaline, brittle and very thin, with fine transverse, striae running outwards from the suture and interrupted by two parallel spiral grooves on the external surface.

In spite of the thinness of the operculum the spirit in which my specimens were preserved has not penetrated it and the soft parts are in rather bad condition. The eyes are very small; the tentacles thin, tapering and short, marked with dark pigment. The snout is narrower than it is shown in Rathouis's figures of *B. humida* published by Heude. The penis is blunt, simple and rather short. The ovaries are well developed in female specimens.

Greatest length of shell 2·5 mm. Greatest breadth 0·73 mm. Length of aperture 0·85 mm. Breadth of aperture 0·42 mm.

Type-specimen. M. 10460/2, Zool. Survey of India (*Ind. Mus.*).

Locality. Tai-Hu (Great Lake), Kiangsu Province, China.

The species is closely allied to *B. humida*, but is distinguished by its smaller size, the colourless shell with well defined microscopic sculpture, the last whorl not projecting and the oval aperture.

My specimens were dredged in 3 metres of water from a muddy bottom without weeds but with a certain amount of decayed vegetation. They were taken in large numbers. The exact position was a little N.E. of the island Si Dong Ding. The species was not obtained at other dredging stations.

Genus **Stenothyra**, Benson.

The species of this genus, which are probably numerous throughout the coastal districts of southern and eastern Asia, are imperfectly known so far as China is concerned. Heude (*op. cit.*, p. 173) figures only one (*S. toucheana*) from the Yangtse valley. He expresses the opinion, however, that there are a considerable number of species on the coast of China. The genus is usually estuarine, at home in brackish water and water of variable salinity. The only species we obtained in the Tai-Hu is well characterized by the strong sculpture of its shell.

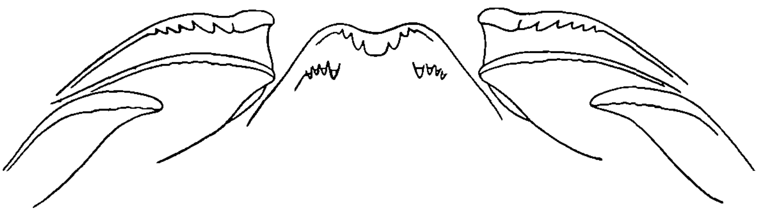


FIG. 2.—Radular teeth of *Stenothyra decapitata*, sp. nov.

Stenothyra decapitata, sp. nov.

Shell small, solid, broadly spindle-shaped, probably blunt at the apex when perfect, always eroded, with not more than 3½ whorls remaining, pale flavous or olivaceous, sometimes stained dark chocolate-brown, translucent, smooth but not highly polished, ornamented with numerous (about 20 on the body-whorl) spiral rows of minute punctures, with still more minute spiral striae between the rows. Suture impressed, whorls somewhat inflated. Body-whorl obesely elongate, more than twice as long as spire, slightly flattened on the ventral surface, subumbilicate. Aperture prominent, surrounded by a well-defined rim, subcircular, relatively large.

Operculum thick but horny, brownish or yellowish, polished on the external surface, with well-marked spiral striae, with the nuclear region concave and occupying more than a third of the whole.

Radula very like that of *S. toucheana* as figured by Heude and Rathouis (*op. cit.*, pl. xxxii, fig. 13) but with 5 instead of 3 upper denticulations on the central tooth, the lateral teeth narrower and the inner lateral tooth with the denticulations better developed.

Length of shell 3·5 mm. Greatest breadth of shell 2 mm. Length of aperture 1 mm. Breadth of aperture 0·75 mm.

The species is related to *S. monilifera*, Benson, but the shell is stouter and probably shorter when complete, its aperture is smaller and relatively broader and its sculpture more distinct.

Type-specimen. M. 11305/2. Zool. Survey of India (*Ind. Mus.*).

Locality. Bottom of Tai-Hu (Great Lake), Kiangsu Province, China.

The species is abundant on a bottom of bare mud in from 2 to 3 metres of water.

Genus **Pseudovivipara**, gen. nov.

Shell large, thin, resembling that of *Vivipara* but more elongate, oblong, conical, umbilicate, with the aperture large and ovate, with the collumellar lip thickened but the outer lip sharp, with the surface ornamented with prominent spiral ridges.

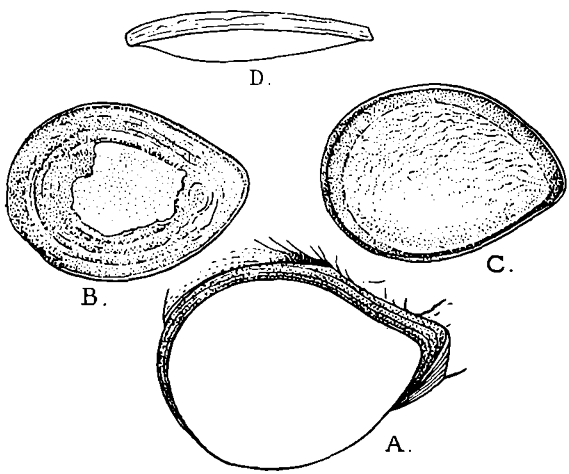


FIG. 3.—Mouth of shell and operculum of *Pseudovivipara hypocrites*, sp. nov.
A, mouth of shell; B, external view of operculum; C, internal view of operculum; D, operculum in profile.

Operculum calcareous, thick, large, concentric, covered with a thick horny epidermis externally and with concentric striae on the external surface, internally convex with a narrow flattened margin, almost smooth, with obscure vermicular sculpturing.

Animal resembling that of *Bithynia*, with a stout proboscis and a branched penis, but with degenerate eyes.

Radula with a pair of denticulations at each side of the base of the central tooth and with a lobular process at the outer margin of the marginal teeth.

Type-species.—*Pseudovivipara hypocrites*, sp. nov.

Distribution. Tai-Hu, Kiangsu and (?) Hainan.

Although I describe *Pseudovivipara hypocrites* as a new genus and species, I am by no means sure that the shell of another phase has not already been figured by both Heude and Kobelt under the names *Paludina boettgeri* and *Vivipara boettgeri*, Möllendorf.

The shell of my type-specimen agrees in almost every respect, except that it is smaller and more eroded, with Heude's figures (*op. cit.*, 1882, pl. xl, fig. 6); it agrees equally well with Kobelt's fig. 7 (*op. cit.*, 1909: pl. 26), which seems to have been drawn from the same shell. Its operculum is, however, quite different from Kobelt's figures 1*a*, 1*b* on the same plate, and the animal is that of a Hydrobiid, not a *Vivipara*. The operculum figured by Kobelt is evidently the operculum of a *Vivipara* and is presumably that of one of the shells figured in figs. 1-6 on the plate. We have, therefore, this unexpected fact, that in certain parts of China two molluscs belonging to different families occur together, or at any rate in the same locality, which are so like that they have deceived even conchologists of the experience of Möllendorf and of Kobelt, for the latter says that his figures are taken from specimens in Möllendorf's collection.

Pseudovivipara is apparently related to the genera *Fossarulus* and *Prososthenia*, Neumayr, both of which were originally described from fossil species from the Tertiary of Dalmatia; it is perhaps still more closely related to *Tylopoma*, Brusina [1], from similar beds in Eastern Europe. From *Fossarulus* it is distinguished by the sharp outer

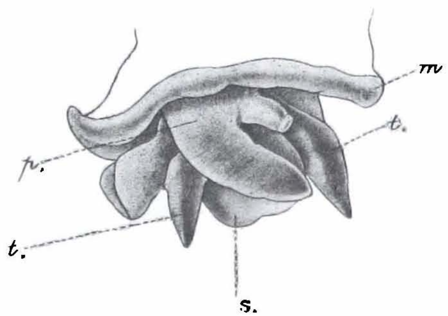


FIG. 4.—Head and adjacent parts of male of *Pseudovivipara hypocrites*, sp. nov.
m. = edge of mouth: p. = penis: s. = snout: t. = tentacle.

lip of the shell, from *Prososthenia* by its calcareous operculum; the operculum of *Tylopoma* is calcareous, but seems to differ in structure. Both *Fossarulus* [1] and *Prososthenia* have been recorded living or subfossil from China,[2] but the synonomy of the genera [3] is a little doubtful and the confusion that has apparently occurred about *Pseudovivipara hypocrites* must render the generic identity of recent and fossil species still more open to question.

Pseudovivipara hypocrites, sp. nov.

The shell is relatively large and thin. It is of elongate conical form but much eroded at the apex in the specimens examined. The suture is not impressed and the

[1] See Brusina, *Beitr. Paläont. Osterreich-Ungarns*, II, p. 73 (foot-note): 1882; also Neumayr, *Abh. K. K. geol. Reichsanstalt*, VII, pl. viii, fig. 20 (1875).

[2] Col. Godwin-Austen has shown, in a note to be issued in the *Rec. Ind. Mus.*, that the Indian species assigned provisionally to this genus or subgenus by Nevill in his "Hand-List" and by Preston in the volume in the "Fauna" is in no way related to it.

[3] See Gredler, *Jahrb. Malak. Gesells.*, VIII, p. 120 (1881); Fischer, *Man. Conch.*, p. 729 (1887); Neumayr, *Neues Jahrb. Min. Geol.*, II, p. 21 (1883) and "Süssw. Moll." in *Wiss. Ergebn. Reis. Béla Széchenyi*, II, pp. 652, 653 (1887).

whorls increase gradually and regularly. It is clothed with a polished epidermis of a deep chocolate-brown colour, which in the natural state is covered by an earthy deposit. Only three complete whorls remain in the specimens, but if they were not eroded at least five would be present. On the body-whorl there are three blunt continuous spiral ridges the lowest of which, lying very near the middle ridge, is almost obsolescent. On the other whorls there are two well-developed ridges. The surface is further ornamented with numerous coarse oblique longitudinal striae set close together. The aperture is ovate, pointed and a little folded anteriorly; its inner margin is prominent and thickened but not very much flattened. The shell is narrowly umbilicate. The inner surface is greyish blue and highly polished.

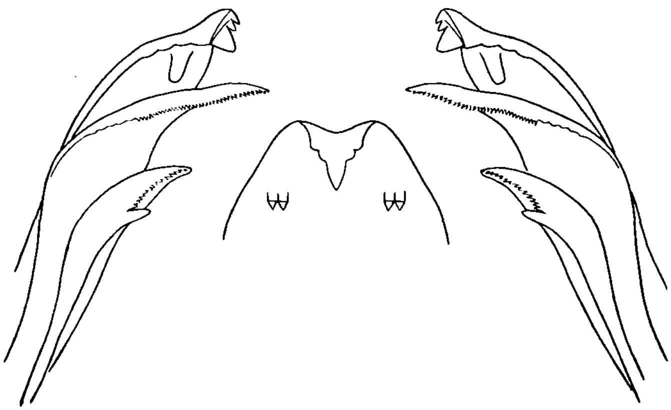


FIG. 5.—Radular teeth of *Pseudovivipara hypocrites*, sp. nov.

Measurements (in millimetres) of three shells.

	Type.		
Length of shell	17·5	14·5	14
Greatest breadth of shell ..	10·6	10	9·5
Length of aperture ..	8·5	7·3	7·5
Breadth of aperture ..	6	5	5
Length of operculum ..	8		
Breadth of operculum ..	5·6		

The operculum is large and thick, pyriform, almost bilaterally symmetrical, of an opaque white colour and porcelainous in texture but covered externally with a coarse chestnut epidermis, which is somewhat eroded in the central region. This region is deeply concave; the external sculpturing is obscure, but concentric striae can be detected on the epidermis. The convex part of the inner surface is smooth except for obscure vermicular ridges of indefinite arrangement.

In most respects the soft parts resemble externally those of *Bithynia*. Both the tentacles and the snout are relatively stout and broad; the former are somewhat flattened but tapering, the latter is blunt at the tip and only very slightly emarginate. The foot is ovoid in shape, pointed but not produced posteriorly and slightly emarginate in front. The eyes are degenerate but are apparently represented by swellings at the outer base of each tentacle. The penis has a lateral branch; the whole structure is very large, broad and somewhat flattened, the main trunk tapering, the lateral process, which is well developed, blunt at the tip. The dorsal surface of the head and foot are blackish, the tips of the tentacles black and that of the lateral branch of the penis white.

The radula is of the Hydrobiid type, but approaches that of the Rissoidae in some respects. The central tooth is small; it bears on its base, well within the margin on either side, a pair of cylindrical processes ending in short spinelets; the cusp is narrowly triangular, with a triangular process in the centre and two coarse denticulations at either side. The internal lateral tooth is broad; its upper margin is armed at the inner edge with three bluntly pointed processes of which the innermost is much the largest; the remainder of this margin is coarsely, bluntly and evenly serrated. The outer lateral tooth is also broad; its denticulations, which are confined to the upper margin, are minute, blunt and even. The marginal tooth is much narrower; its denticulations resemble those of the tooth next to it, but it bears a narrow, bluntly pointed process of considerable relative length at the outer extremity of the upper margin. All the teeth are rather small, delicate and of a pale yellowish colour. The whole radula is small and narrow.

Type-specimen. No. M 10415/2, Zool. Survey of India (*Ind. Mus.*).

Locality. Narrow creek at Tong Dong Ding, Tai-Hu, China.

Three specimens of *P. hypocrites* were dredged from a depth of about 3 metres. They were apparently living among weeds on a muddy bottom. The specimen selected as the type-specimen and figured on pl. x is considerably more elongate and larger than the other two. It is an adult male.

This specimen was obtained in December, 1915. After remaining dry for some months in Calcutta it was sent to London. It was sent back to Calcutta in January, 1918. When the operculum was removed recently the soft parts were found to be in excellent condition and still damp, after the shell had been dry for more than two years. The stout operculum is probably, therefore, of use to the animal, should the water in which it lives chance to dry up, in enabling it to store up moisture inside the shell for long periods. It is probable that the individual examined had lived out of water for at least two years, through the greater part of a hot weather in Calcutta and part of a winter in England. It must have died only a short time before I examined it, if it were really dead. In a smaller individual, however, with exactly the same history the body was hard, dry and shrivelled.

Family ASSIMINEIDAE.

Genus **Assiminea**, Gray.

Assiminea scalaris, Heude.

1882. *Assiminea scalaris*, Heude, *op. cit.*, p. 83, pl. xxi, figs. 5, 5*a* 5*b*, 5*c*.

As Heude's work is not always accessible I quote his description of the shell.

"A. testa parva, perforata, subsolida, cornea, vix striatula, carenis pluribus valde caducis circumcincta; spira acuta, anfractibus 7, planulis, sutura scalari junctis; ultimo ad peripheriam confuse angulato; apertura vix obliqua, ovali; peristomate acuto margine columellari brevissimo, nec incrassato, nec dilatato, aliquantulum sinuoso; umbilico angusto, bene perforato, in canalem columellarem margine carinatum producto. Altit: 5½; latit: 4½ millim."

Shells from the Tai-Hu and from the Whangpoo near Shanghai vary greatly in size and shape. The following measurements (in millimetres) are those of specimens from the lake.

Length.	Breadth.	Aperture.
5·5	4·0	2·75 × 2·0
4·7	3·75	2·5 × 1·5
5·2	3·5	2·5 × 1·5

The external surface of the shell when not eroded is of a deep horn-colour. The inner surface is polished and of much the same colour, except immediately round the aperture, where it is whitish. When the epidermis is worn away fine longitudinal striae appear on the shell.

I can detect no constant difference between specimens from the river and those from the lake. In both localities the species is quasi-aquatic rather than aquatic, adhering in large numbers to damp stones just above the water-line. At the edge of the Whangpoo it is found with *A. haematina*, Heude, which is, however, much less abundant and apparently not gregarious. *A. scalaris* was described from "*parietes*" near Shanghai. It evidently resembles the Indian *A. francesiae*, Gray in habits and, like that species, makes its way for a considerable distance inland in estuarine tracts, well beyond the limits of brackish water.

Family VIVIPARIDAE.

Genus **Vivipara**, Lamarck.

The genus is represented in the Tai-Hu by a large species of the *V. chinensis* group and also by a dwarfed form of a species belonging to a curious and interesting group the first member of which to be described was *V. angulata* (Müller). The perhaps more characteristic *V. quadrata* (Benson) and a number of closely related species or races figured by Heude also belong to the group, which is found widely distributed in the watersheds of the Yangtse and the Canton river. The shell is characterized by the more or less irregular and inconstant spiral ridges and coarse longitudinal striae with which it is ornamented. These peculiarities are, however, much less accentuated than in the western Chinese genus *Margarya*, Nevill, in which the shell is also much larger and thicker.

Vivipara lapillorum (Heude).

1882. *Paludina lapillorum*, Heude, *op. cip.*, p. 177, pl. xl, figs. 11, 11*a*.
1909. *Vivipara lapillorum*, Kobelt, *Paludina* in Chemnitz's *Conch.-Cab.* (ed. Küster), p. 122, pl. xxv, figs. 14-17 (*lapillosa*).

Kobelt regards this species as no more than a variety at most of Benson's *Paludina quadrata*, but it differs from all the forms that can be legitimately assigned to that species or to *V. angulata* (Müller) in the rounded and more or less flattened apex of the shell. This feature is concealed to some extent by erosion in all the adult shells I have examined, but is well exemplified in young shells from the Tai-Hu.

Specimens from the Tai-Hu and Soochow differ from Heude's figures in their smaller size and rather greater relative breadth of shell. They vary, however, considerably in the latter character. I give measurements (in millimetres) of three specimens.

Length.	Breadth.	Aperture.
19·5	14·0	9·5 × 7·0
21·5	14·5	10·0 × 7·0
19·0	13·5	9·25 × 7·25.

The shells also vary in the number of spiral ridges and their relative development. In some the epidermis covering the ridges is frayed in such a way as to form rows of "cilia", and in others these structures assume the appearance of micro-

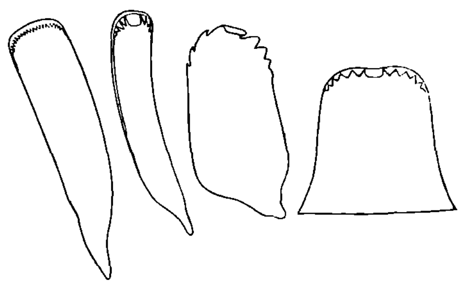


FIG. 6.—Radular teeth of *Vivipara lapillorum*.

scopic spines. In some, however, there is no trace of any such peculiarity. The epidermis is of a pale green colour, with occasional longitudinal blackish streaks. The margin of the aperture is sometimes blackish. The shells have a distorted and dwarfed appearance doubtless due to some peculiarity of their environment. The surface even in quite young individuals is always eroded.

The operculum is thin and horny but of a very dark brown colour. It is rather narrowly pyriform and has the posterior extremity bluntly pointed and very slightly retroverted. The outline is almost bilaterally symmetrical. The external surface is concave as a whole and surrounded with several concentric ridges. The internal scar is relatively large.

The radular teeth (fig. 5) are large and of a yellowish colour. The denticulation of the lateral teeth is unusually coarse and well-developed.

This dwarfed phase of *V. lapillorum* is common on stones and bricks at the edge of the Tai-Hu and also in canals at Soochow. Heude's statement as to the type locality and habitual environment of the species is by no means clear.

Vivipara catayensis (Heude).

1882. *Paludina catayensis*, Heude, *op. cit.*, *p.* 174, pl. xxxix, fig. 10.
1909. *Vivipara* (*chinensis?* subsp.) *cathayensis*, Kobelt, *op. cit.*, p. 112, pl. xviii, figs. 5, 6.

My specimens from the Tai-Hu vary in shape and sculpture and seem to provide a complete transition, so far as these are concerned, between *V. catayensis* as figured by Heude and by Kobelt and *V. ussuriensis* as figured by the latter author (*op. cit.*, pl. xviii, fig. 1-4). In shells from Mukden, however, which Dr. T. Kawamura has recently sent me and which I believe to represent the true *V. ussuriensis*, the mouth is narrower and longer and the shell thinner and less opaque; the black margin of the lip is also narrower. It is probable, therefore, that the Tai-Hu form, which must bear the name *catayensis*, should be regarded as a local race of the northern species *V. ussuriensis*.

This large and handsome *Vivipara* occurs in considerable abundance among weeds in creeks round the Tai-Hu. It is not found, however, in the open parts of the lake.

LAMELLIBRANCHIATA.

Family MYTILIDAE.

Two species of true mussels, *Mytilus martensi*, Neumayr[1] and *Modiola lacustris*, v. Martens, have been found in fresh water in the Yangtse system. Only one of these occurs in the Tai-Hu.

Genus **Modiola, Lamarck.**

In western countries this genus is exclusively marine and even in the Bay of Bengal a species (*M. watsoni*, Smith) occurs at depths of over 100 fathoms. At least two Indian species have, however, established themselves in estuarine tracts in brackish water and water of variable salinity, while in Siam and Cambodia allied forms are fluviatile and in China *M. lacustris* lives in the Tung-Ting Lake hundreds of miles inland.

The precise relations of the Far Eastern freshwater forms are still obscure. I have examined co-types of *M. lacustris* from the Tung-Ting Lake and also what are probably co-types of *M. cambodjensis*, Morlet from Cambodia, as well as a series of shells from the Hang river in Corea, recently sent me by T. Kawamura. The differences between them do not seem to me any greater, if so great, as those between the different phases of *M. striatula*[2] recently discussed by Mr. S. W. Kemp and myself. Indeed, I think it not at all improbable that all are merely races of that species. I have not, however, material for a full discussion of the question. The form I name *M. lacustris* is, I am convinced, identical specifically with the one described under that name by von Martens, but it is not improbable that his species will finally rest in the synonomy of some other.

Modiola lacustris, v. Martens.

1875. *Modiola lacustris*, v. Martens, *Malacoz. Blätt.* f. 1874 and 1875, p. 186.
? 1870 1876. *Modiola lacustris*, Pfeiffer, *Nov. Conch.* IV, p. 154, pl. cxxxv, figs. 2, 3.
1881. *Modiola lacustris*, v. Martens, *Conch. Mitth.* I, p. 97.

[1] Neumayr, "Sussw.-Moll." in *Wiss. Ergebn Béla Szechenyi* II, p. 640 (1887).
[2] Annandale and Kemp, *Mem. Ind Mus.* V, pp. 358-364, pl. xv (1916).

The following measurements are those of a number of freshwater specimens of *Modiola* from China, Corea and Cambodia :—

Modiola lacustris.	Length.	Breadth.	Thickness.
Tung-Ting Lake, Hunan (co-types).	22·3	9·5	8·5
	17·0	7·5	6·5
Tai-Hu, Kiangsu.	13·5	6·5	6·0
	15·0	7·5	5·5
	15·25	7·5	5·5
	13·8	7·6	5·6
	13·5	7·1	6·0
	14·5	6·8	5·2
Hang R., Corea.	31·0	12·5	11·75
	30·0	12·0	11·5
	22·5	9·75	8·75
	18·5	8·75	7·0
	18·6	8·7	6·4
	17·25	8·2	6·0
Modiola cambodjensis.			
Cambodia (? co-types).	26·25	12·25	9·6
	23·75	11·5	
	25·20	11·3	

The average length-breadth index of the two co-types of *M. lacustris* is, therefore, 43·36, that of the Tai-Hu specimens 50·17 and that of the Corean specimens, 45·38, while that of those of *M. cambodjensis* is 46·41. In each lot there is considerable variation in outline. The Tai-Hu shells are much the smallest. These shells vary considerably in colouration and four colour-forms may be distinguished, though they fade one into another. Some shells are uniform or almost uniform pale greenish yellow, in some a dark purple colour predominates, in others the yellow is marked with broad longitudinal streaks of purple, while in a few the upper half of the shell is purple and the lower half yellow. The Corean shells are all of a dark olivaceous brown with a tinge of purple.

M. lacustris is common at the edge of the Tai-Hu on small stones and on the roots of willows, on which it often forms large masses. We dredged a few living specimens from the middle of the lake. Colonies of the hydroid *Cordylophora lacustris* and the Ctenostomatous polyzoon *Paludicella elongata* were found attached to the masses of shells.

Family UNIONIDAE.

Genus **Anodonta,** Lamarck.

Anodonta woodiana (Lea).

1834. *Symplynota woodiana*, Lea, *Trans. American Phil. Soc.*, V, p. 42, pl. v, fig. 13.

1876. *Anodonta woodiana*, Clessin, *Anodonta* in *Chemnitz's Conch.-Cab.* ed. Küster, p. 146, pl. xlviii, figs. 1, 2.

1900. *Anodonta woodiana* (in part), Simpson, *Proc. U.S. Nat. Mus.*, XXII, p. 637.

1916. *Anodonta woodiana*, Annandale, *Mem. As. Soc. Bengal*, VI, p. 49, pl. iii, figs. 9*a*, 9*b*.

Specimens from the Tai-Hu agree well with Lea's original figure. They are considerably smaller than some from Shanghai in the collection of the Indian Museum. The measurements of a large shell from the lake are 100 × 65 × 36 mm. The inner margin is pale olivaceous, the epidermis dark olivaceous.

A. woodiana is common in creeks with the two species of *Nodularia*. The Polyzoa *Paludicella elongata* and *Hislopia cambodgiensis* are often found on living shells and the leech *Hemiclepsis casmiana*, Oka[1] is parasitic on the animal.

Genus **Nodularia,** Conrad.

Nodularia dactylina (Heude).

1895. *Unio dactylina*, Heude, *Conch. Fluv. Nanking*, pt. IX, pl. lxv.
1900. *Nodularia douglasiae* (in part) Simpson, *Proc. U.S. Nat. Mus.*, XXII, p. 808.
1910. *Nodularia douglasiae*, Haas, *Unioniden* in *Chemnitz's Conch.-Cab.*, (ed. Kobelt), p. 68 (in part), pl. vi, fig. 5.

Haas treats both this and the succeeding species as mere "formae" of *N. douglasiae* (Griff. and Pidg.) and Simpson refers to it as possibly worthy of a varietal name, but as the two occur together, are seemingly constant, without intermediate specimens, I think it better to regard them as distinct. Specimens from the Tai-Hu agree well with Haas's figure. Our largest shell is 64 mm. long, 30 mm. deep and 23 mm. thick.

N. dactylina is common, with *N. douglasiae*, in shallow creeks and channels at the edge of the Tai-Hu and between islands in the lake. It is recorded from Ningpo.

Nodularia douglasiae (Griff.).

1845. *Unio osbecki*, Philippi, *Zeits. Mal.*, p. 164.
1910. *Nodularia douglesiae*, Haas, *op. cit.*, p. 68 (in part), pl. vi. figs. 6, 7.

Specimens from the Tai-Hu agree well with Haas's fig. 6, but are larger, the measurements of a well-developed shell being 51 mm. × 25 mm. × 15 mm. The species is as common as *N. dactylina*. It is said to be found in Central China. The leech *Hemiclepsis casmiana*, Oka[1] was found parasitic upon it also.

Family CYRENIDAE.

Genus **Corbicula,** Megerle.

Corbicula sandai, Reinhardt.

1878. *Corbicula Sandai*, Reinhard, *Jahrb. Malak. Gesell.*, V, p. 187, pl. v, fig. 2.
1881. ? *Corbicula largillierti*, var., A. Heude, *op. cit.*, pl. 1, fig. la.
1907. *Corbicula Sandai*, Pilsbry, *Annot. Zool. Japon.*, VI, p. 157, pl. vii, figs. 17, 18.
1916. *Corbicula sandai*, Annandale, *Mem. As. Soc. Bengal*, VI, p. 51, pl. iii, fig. 12.

Shells from the Tai-Hu seem to belong to this species, the hinges and teeth being quite characteristic. They exhibit, however, considerable variation in outline and are all small and more or less eroded. The relative lengths of the lateral teeth are somewhat variable.

[1] Oka, *Mem. As. Soc. Bengal*, VI, p. 167 (1917)

The following are the measurements of three specimens :—

Length.	Depth.	Thickness.
14·5	13·5	9·75
14·0	13·3	7·7
18·2	18·2	12·8
17·5	17·5	13·75

The epidermis varies in colour from pale olivaceous to almost black. The inner surface is tinged with violet.

The shells from the Tai-Hu perhaps represent a dwarfed phase of the form figured by Heude under the name *C. largillierti* var. A, which also came from a lake in the Yangtse delta. I have examined a series of small shells from the Tung-Ting lake in Hunan named, apparently by von Martens, "*Corbicula fluminea*, Müll." These shells are hardly larger than those from the Tai-Hu, from which they differ only in being on an average a little broader in proportion, and in having the ridges on the external surface a little more regular. They differ from the normal *C. fluminea* in their smaller size, thicker shell and stronger teeth, but the eastern species of *Corbicula* are still in great confusion and so far as those of China are concerned, Pilsbry (*op. cit.*, *supra*, p. 153) says with justice, "In dealing with the Chinese species Père Heude has attempted to name every local form, a task I believe to be practically impossible, and if accomplished the result would be absolutely useless to any other zoologist from the impossibility of again recognising the forms."

The species occurs in great abundance on the muddy bed of the Tai-Hu, where it is markedly gregarious. It is widely distributed in the southern part of Japan and has been recorded from Tonquin.

Genus **Sphaerium**, Scopoli.

Two small shells (living) of this genus were dredged off the island Si Dong Ding, but as both are broken I do not attempt to name them specifically.

Note on the Supposed Occurrence of the Genus *Arca* with Freshwater Molluscs in the Yangste.

Neumayr[1] in his account on the freshwater molluscs collected in China by Count Béla Széchenyi describes a true *Arca* under the name *Arca granulosa* var. *minuta*. Apparently *granulosa* is a slip for *granosa*. He states that a single shell of this form was found, with specimens of *Bithynia*, *Vivipara*, *Melania* and *Corbicula*, in a recent deposit 50 miles inland from the mouth of the Yangtse. *Arca granosa*, Linn. is one of the commonest and most characteristic molluscs of brackish water on the coasts of India and other parts of south-eastern Asia and is always more or less dwarfed when living in water of low salinity. In the sea it attains a large size. There are specimens from the Nicobars in the collection of the Indian Museum over 75 mm. broad. In the inner parts of the Chilka Lake on the eastern coast of India, on the other hand, where the water is never more than slightly salt, Mr. Kemp and I found no living shell more than 26 mm. in breadth. We have discussed the living and sub-

[1] *Wiss. Ergebn. Reise. Béla Széchenyi I, Sussw.-Moll.*, p. 641, pl. i, fig. 4 (1887).

fossil shells of the species found in that district in a recent paper.[1] I was, therefore, interested to notice similar shells lying about in the village of Moo-Too between Soochow and the Tai-Hu. On inquiry, however, we learnt that they were the shells of molluscs sold in shops as food and not procured locally. On visiting the provision shops in the village we saw large quantities on sale and were informed that they were brought from Ningpo. Those on sale were mixed with shells of *Nassa* and *Potamides* that had a distinctly estuarine facies; shells of *Balanus* were attached to some of them. I figure three shells purchased in a living condition at Moo-Too. They agree with Neumayr's figures in their approach to bilateral symmetry as well as in being very small, though they vary somewhat in the latter feature. They also agree in these respects with living shells from water of low salinity in the Chilka Lake (*op. cit.*, pl. xvi, fig. 6). Beside them I figure a shell of a small phase sold in the bazaar at Singapore and said to be obtained from beds in the harbour. In this phase bilateral asymmetry is much more marked. Neumayr's var. *minuta* is in all probability, therefore, a dwarfed form that lives in water of low salinity, but there is no real evidence that it lived or still lives so far up the Yangtse as Neumayr thought. Capt. A. F. Cole, R.A.M.C., who was for many years resident at Ningpo, tells me that water of very different salinities is to be found in the immediate neighbourhood of that place.

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[1] *Mem. Ind. Mus.*, V, pp. 338, 350, pl. xvi, figs. 3-6 (1916).

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EXPLANATION OF PLATE X.

PHOTOGRAPHS OF SHELLS.

Stenothyra decapitata, sp. nov.

FIG. 1.—Eleven specimens from the Tai-Hu, × 7.

Hypsobia minuscula, sp. nov.

FIG. 2.—Eleven specimens from the Tai-Hu, × 7.

Pseudovivipara hypocrites, gen. et sp. nov.

FIGS. 3, 3*a*.—Type-shell, × 2.

Vivipara lapillorum (Heude).

FIG. 4.—Shell from the Tai-Hu without epidermal cilia, × 2.
FIG. 5.—Young shell from the same lake, × 2.
FIG. 6.—Shell with epidermal cilia from the same locality, × 2.

Modiola lacustris, v. Martens.

FIGS. 7, 8, 9.—Three shells from the Tai-Hu, all × 2.

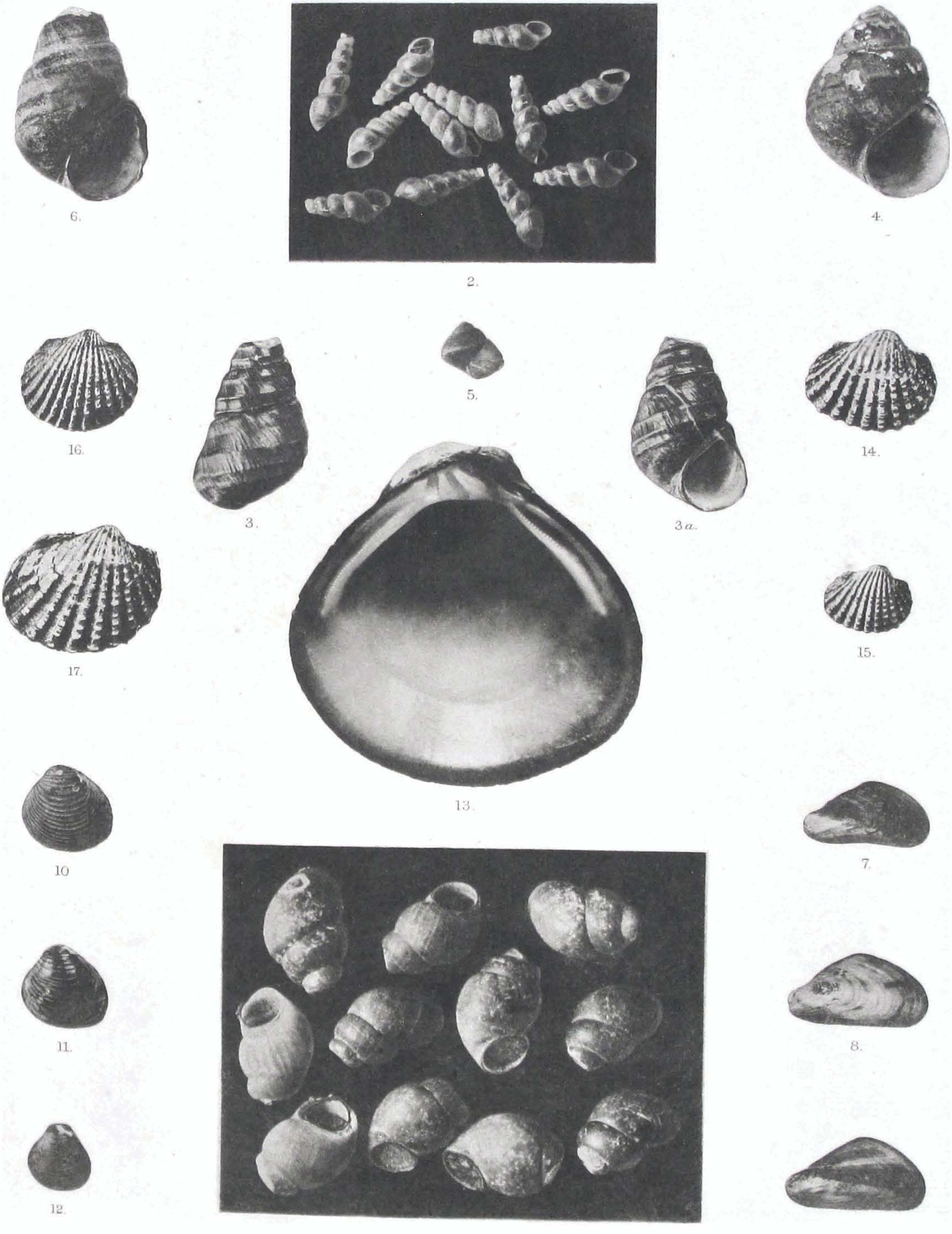
Corbicula sandai, Reinhardt.

FIG. 10.—Shell from the Tung-Ting Lake, Central China, Nat. size. Identified by (?) von Martens as *C. fluminea*, Müll.
FIGS. 11, 12.—Shells from the Tai-Hu. Nat. size.
FIG. 13. Internal view of a shell from the Tai-Hu, × 5.

Arca granosa, Linn.

FIGS. 14, 15, 16.—Shells of the var. *minuta*, Neumayr purchased in a living condition at Moo-Too near Tai-Hu, but said to have been brought from Ningpo. Nat. size.
FIG. 17.—Shell of a small phase from Singapore purchased in the market and said to have come from the harbour. Nat. size.

PLATE



MEMOIRS

OF THE

ASIATIC SOCIETY OF BENGAL

VOL. VI, pp. 321—396.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

EDITED BY N. ANNANDALE, D.Sc., F.A.S.B.

PART VI.

CALCUTTA:

PRINTED AT THE BAPTIST MISSION PRESS, AND PUBLISHED BY
THE ASIATIC SOCIETY, 1, PARK STREET.

1919.

Price Rs. 2; or 4*s*.

27-9-19.

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PART VI.

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Mem. Asiat. Soc. Bengal, Vol. VI.

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CONTENTS.

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ECHIUROIDS FROM BRACKISH WATER, WITH THE DESCRIPTION OF A NEW SPECIES FROM THE ANDAMANS.

By B. PRASHAD, *D.Sc.*

[With plate XI.]

INTRODUCTION.

Dr. Annandale in his tour in the Far East obtained from the Talé Sap a single specimen of the genus *Thalassema*, Gaertner. This specimen was entrusted to me for description. The specimen was identified as *T. sabinum*, Lanchester (7), the type specimens of which were obtained by the "Skeat Expedition" from the same lake. Lanchester's description of the species is quite inadequate and I have therefore found it necessary to describe the anatomy of the form in detail. I have also taken this opportunity to describe the comparative anatomy of the two other oriental species which like *T. sabinum* have been found in brackish water.

In the collection of the Zoological Survey of India[1] I discovered another interesting specimen of the genus *Thalassema*. This was collected by Mr. S. W. Kemp, Superintendent, Zoological Survey, in the Andaman Islands. A description of it is also included here, as it appears to be a new and undescribed form.

At the time of the working out of the Echiuroids of the Chilka Lake and the Gangetic Delta (2) the authors had a very limited material of the species *T. dendrorhynchus* and *T. branchiorhynchus*, and hence many interesting details of the anatomy were left untouched. Since then, thanks to the untiring energy of the officers of the Survey, a large number of specimens of *T. branchiorhynchus* has been collected at Chandipore near Balasore in Orissa by Dr. F. H. Gravely. All this valuable material, together with the type specimens of the new species, was placed at my disposal by Dr. Annandale, to whom my best thanks are due for the same and for kindly allowing me to take this valuable material with me to Lahore on the occasion of a recent holiday. Most of the work was completed in the Zoological Laboratory of the Government College, Lahore, and I am deeply indebted to my friend and former professor Lt.-Colonel J. Stephenson, D.Sc., I.M.S., professor of Zoology and Principal, Government College, Lahore, for allowing me the use of his Laboratory and making me comfortable in every way throughout my stay.

I am also highly obliged to Mr. T. Southwell, F.Z.S., A.R.C.S., Director of

[1] Unfortunately most of the Echiuroid collection of the Zoological Survey of India is lying interned in Germany owing to the war.

Fisheries, Bengal, Bihar and Orissa, for kindly allowing me to continue my zoological studies in my spare time and for permission to publish this paper.

In this paper I have devoted special attention to the structure of the proboscis, the segmental organs and the anal vesicles, structures which seemed to have a special interest in this group of species and required investigation.

ORIENTAL ECHIUROIDEA OF BRACKISH WATER.

External Characters :—I have nothing to add to the admirable account of the external characters of *T. dendrorhynchns* and *T. branchiorhynchus* by Annandale and Kemp (2), but a few remarks about the natural colouration, other external characters and the locality of *T. sabinum* are given as a supplement to Lanchester's description (7).

Dr. Annandale's single specimen was collected in the inner end of the outer channel of the Talé Sap on the 30th of January, 1916. The specific gravity of the water corrected to 15°C. was 1·004. The animal was found living in soft mud containing dead shells.

In the living specimen the integument was colourless and hyaline, with minute, round and colourless papillae. Anal vesicles tinged with yellow; intestine full of mud; hooks very slender, silvery, in preserved specimen rather yellowish; nerve cord opaque, seen through the integument; proboscis less hyaline than the body, capable of considerable change of shape but not very extensile, ventral margin not fused. The animal wriggled slowly and contracted itself at various points, and formed a sheath of mud round itself.

In the preserved specimen the skin has a creamy colour. The papillae as shown in text fig. 1, are very minute, and collected together on the anterior third of the body. Over the rest of the surface there are nearly regular rows of large papillae alternating with much smaller ones. The preserved specimen measured 11 mm. in length.

FIG. 1.—*Thalassema sabinum*. Lanchester, as seen from the upper surface.

Setae :—The setae of *T. sabinum* are of the normal type. In *T. dendrorhynchus* and *T. branchiorhynchus* in accordance with their habitat (which is discussed at length in the account of the proboscis) they are modified; in the latter form more so than in the former.

In *T. branchiorhynchus* the setae (fig. 1) are rather long and specially curved at the anterior end; this curved portion is always outside the body while the straight portion projects into the body-cavity, and the large radiating muscles on the ventral surface of the body-wall anteriorly are attached to its base. The curved outer portion seen in a side view is pointed; viewed from above it has the distal end specially thickened along the outer edge and sharpened along the inner. This inner edge acts as a blade when the setae are protruded forwards and is used for holding on and burrowing in the dense mud.

In *T. dendrorhynchus* the development of the blade-like portion is not so far advanced.

The transverse striations along the straight shaft and the curved portion of the setae, as shown in the figure, mark the regions of growth. In a specimen I found the tip of a new seta lying in the body-cavity; only the tip had been secreted while the rest of the seta had not yet been formed.

Proboscis :—This structure in these species has a special interest, in that it shows a regularly ascending evolutionary series in the development of much divided processes from the edges of the proboscis. *T. branchiorhynchus* is the most highly evolved, *T. dendrorhynchus* is in an intermediate grade, while *T. sabinum* shows only the beginning of the formation of these structures. For the sake of convenience I have in this account referred to these processes as gills, owing to the function which I assign to these structures.

Lanchester in his original description of *T. sabinum* (7) says "Proboscis is short compared with the body" mentioning no gill-like structures or other outgrowths. Annandale and Kemp (8), who re-examined the types, describe the proboscis as having the lateral margins fused, so that the organ is tubular,—"Comparatively long finger-shaped processes arise from its internal surface and protrude at the opening of the tube." From these statements it appears that the form, so far as the proboscis is concerned, is either a highly variable one, or as seems more probable, that the form of the proboscis depends largely on its state of expansion or contraction. In the single well-preserved specimen before me, the proboscis (fig. 2) is a short stumpy structure 1·8 mm. in length, forming one sixth of the whole animal. It has a practically smooth surface. At the base it is a tubular structure and the lateral margins are continuous, and from within these margins small tubular outgrowths project forwards, springing as they do from the inner surface of the tubular portion. Further forwards the two margins are indented and show as it were the beginnings of the formation of gill-like structures. As seen in fig. 2 the processes are rather small, rounded at the tip and in continuation of the proboscis-wall from which they are only divided off by short indentations; some of the processes show a further subdivision. The inner surface along the upper edge shows a few faint longitudinal markings.

The proboscis of *T. dendrorhynchus* has, so far as the external appearance goes, been described at length by Annandale and Kemp in the paper cited, and but for a few remarks about its dendric outgrowths I have nothing to add to that description. These outgrowths (fig. 3) show a very distinct advance on those of *T. sabinum* in that they are more numerous and that the outgrowths themselves are further subdivided. A few, however, are simple and undivided and of the same form as those of *T. sabinum*; these are to be seen here and there between the much divided ones. But all the outgrowths, as has been mentioned by Annandale and Kemp, are small and in length less than half the width of the proboscis.

In the large number of specimens of *T. branchiorhynchus* it was seen, that the gills are not confined to the proximal third of the proboscis only as was the case in the type-specimen, but are often present on more than half of it. Near the base and along the lateral margins up to about half of its length the processes are very large (fig. 4), nearly as long or even longer than the width of the proboscis in some cases. They are much divided structures of a blood red colour in the living specimens, and in the normal situation hang downwards from the margins. Further up, the margins show indentations of the same type as has been described above for *T. dendrorhynchus*. A little beyond the middle of the length of the proboscis the lateral margins are quite smooth and do not show any indentation. The histological structures and the function of these gill-like processes is treated of at length further on.

From the above descriptions it would be seen, that in these three forms there is a nearly complete series in the development of gill-like structures from mere indentations on the margins of the proboscis. By further growth and subdivision this process results in the large branched gills of *T. branchiorhynchus*. The presence of simpler, much less divided protuberances side by side with the highly organized ones is a further proof that the highly evolved structures of *T. branchiorhynchus* have gradually developed in accordance with the needs of the animal.

Another point worth noting as regards the proboscis of all these forms is that, compared with that of the common European form *T. neptuni*, it is much less contractile in comparison with the body, a point probably correlated with the presence of gill-like outgrowths.

As I had only a single specimen of *T. sabinum* I did not section its proboscis as a whole, but a part of the ventro-lateral margins was cut in order to compare the structure of the gill-like prolongations in this species with those of the other two. Transverse sections only of the proboscis of a specimen of *T. dendrorhynchus* were cut, but in the case of *T. branchiorhynchus*, more ample material of which was available, I cut transverse, vertical and horizontal longitudinal sections of the proboscis, besides dissecting the proboscis of another specimen to see the relationships of the various parts.

In a transverse section the appearance of the proboscis of *T. sabinum* would be semicircular. In *T. dendrorhynchus* sections near the base are nearly circular but incomplete ventrally (fig. 5). Near the tip, however, they become semicircular. In *T. branchiorhynchus* the sections are semilunar, at and near the tip, while in the region of the gills large processes are seen hanging down from the two sides of the semilunar sections (fig. 6.).

In the following account of the histology of the proboscis I have described the structures as they occur in *T. branchiorhynchus* (figs. 7-9), noting differences from the other forms. The outer dorsal surface of the transverse section is not smooth, but raised up into small papillar areas, which, however, in no way correspond to the papillae on the body-wall. Proceeding from the external surface the following layers are to be seen—cuticle, epidermis, cutis, longitudinal and circular muscles, connective tissue, and then the above layers in a reverse order up to the epidermis, which is ciliated, there being no cuticle on the ventral surface.

The *cuticle*, which is a continuous layer over the surface of the body and the proboscis, is seen to consist of the following strata: (i) a deeply staining and refractile outer structureless layer (*c.i.*) appearing as a dark border in sections stained with Heidenhain's iron haematoxylin or Dobell's iron haematin. (ii) Underlying the outer layer is a much thicker one (*c.ii.*), which is clearer, stains faintly and shows a fine striation of the type mentioned by Jameson (6) in *T. neptuni*; no alveolar layer can be distinguished under the second layer of the cuticle of the proboscis, but a distinct layer of this type is present in the integument of the body. The *epidermis* (fig. 7) on the dorsal surface of this region consists of large columnar cells (*E.c.*) measuring $12\mu \times 8\mu$ with a large nearly circular nucleus $3{\cdot}5\mu$ in diameter, lying about the middle of the cell, the nucleus has a reticular structure and besides a large nucleolus, a few chromatin granules are also seen lying scattered in its substance. The cells are set closely side by side, leaving here and there space for the openings of the gland cells to be described later. In horizontal longitudinal sections the mosaic appearance of these cells is very distinct; they appear polygonal in outline with the margins of the adjoining cells in close apposition. In transverse sections of the proboscis it is seen that the columnar cells, below the level of the nuclei, are very much smaller than above and end in root-like processes, which are, in places, seen to be connected with those of the adjacent cells. I could not in any case trace a distinct connection between the cell-roots and the nerve or connective tissue-fibres. The protoplasm of the cells is granular, but a fair number of striae can also be seen stretching in a vertical direction. The *gland-cells* (*G.c*) are unicellular, elongated flask-shaped structures with the neck projecting between the epidermal cells and opening to the exterior; the basal part lies as deep as the musculature. The nucleus of these cells (which is circular in outline and resembles that of the ordinary ephithelial cells except that it stains deeper) lies in the swollen basal part, where it is surrounded by undifferentiated protoplasm. The contents of the gland-cells appear to consist of a large number of small granules in a clear matrix. Sensory or *trigger-cells* of the type described by Jameson (6) are present in fair numbers, specially on the lateral margins near the distal end. These sensory cells are found in groups, each consisting of an elongated body with very granular protoplasm, an oval nucleus lying in the basal part, and a small hair projecting out of the cuticle. No direct connection between these cells and the nerve-fibres or nerve-cells could be seen.

There is no sharp basal membrane limiting the basal ends of the epidermal cells. There is, however, a distinct layer of *cutis* (*Cu*), which consists of a clear ground substance with numerous irregularly branching fibres traversing it; a few elongated cells are to be seen connected with the fibres. It appears as if the fibres were direct continuations of the cells mentioned above.

The *musculature* which underlies the cutis consists of two layers,—(i) an outer longitudinal (*L.m*) and (ii) an inner circular (*C.m.*) one. The layer of longitudinal muscles is fairly thick and like the circular one consists of fine muscle-fibres running side by side. The structure of the fine muscle-fibres is the same as in other Echiuroids.

Between the muscular layers of the upper and those of the lower surface, the space is occupied by the massive connective tissue (*C.t*) in which we can distinguish structurally an outer and an inner portion. The outer one, which is much the smaller and thinner of the two, consists largely of connective tissue-cells of an irregularly polygonal shape; some, however, are distinctly multipolar. The cells are either fused with one another or connected by short processes. The more deeply situated cells, which may be described as a gradation between the outer cells and the internally situated connective tissue-fibres, have longer processes. The number of cells in this part is fewer and their fibres form a loose connective tissue. Here and there nerve-cells and a few pigment corpuscles are also to be seen in this portion of the connective tissue. The fibres are sinuous, and in the middle have a dorso-ventral course, while outside they run more in a longitudinal direction. The connective tissue portion in *T. branchiorhynchus* has a large number of lacunar spaces in the basal gill-bearing portion of the proboscis, further forwards the tissue is much more compact and very few lacunae are visible. The number of these spaces is far fewer in the proboscis of *T. dendrorhynchus*, while practically none could be seen in *T. neptuni*.

Below this deeply situated portion of the connective tissue, the various layers enumerated above appear in a reversed order till we reach the epithelium (*C.e.*) of the ventral surface, which as has been remarked before consists of ciliated cells. These cells are present only on the ventral surface of the proboscis and on the gills. They are of the same type as the columnar epithelium of the dorsal surface of the proboscis but are more elongated, measuring 14 μ by 6 μ and the nucleus is ovoid.

Before describing the histological structure of the gills it is necessary to describe the large number of lacunar spaces (*La.*) which are present in the proboscis of these forms a little above the ventral surface. These spaces, however, are quite distinct from the spaces in the connective tissue mentioned above, and from the blood-vessels of the proboscis to be described later. At the point of junction of the proboscis with the body they consist of two large spaces in direct continuation of the body cavity. Further on the spaces become divided into a large number of small compartments of a triangular or quadrangular outline, and separated from one another by thin septa; as we reach the tip of the proboscis, the adjacent spaces have begun to unite until at the end only a single space is to be seen. The number of these spaces is much larger in *T. branchiorhynchus* than in *T. dendrorhynchus*. The spaces are situated near the ventral margin above the muscular strata and often contain large number of coelomic corpuscles. The outermost of these spaces contain the lateral blood-vessels of the proboscis, and their cavity is continuous with the cavity of the gills (fig. 6); the blood vessels which run through these cavities to the anterior end are held in position by a distinct connection of connective tissue.

The gills (*Gi*) of *T. branchiorhynchus* are hollow filiform outgrowths from the lateral margins of the proboscis and in some cases from the ventral surface near the edge. The filiform processes by further branching and division give rise to the much divided arborescent structures, which are present in this species. The structure of these gills is peculiar. Near the origin they have an outer covering of ciliated epithelial cells of the same nature as those on the ventral surface of the proboscis, and a fairly thick layer of connective tissue cells and fibres, the latter more abundant, lying internal to the epithelium; a few muscle fibres and nerves can also be seen in the connective tissue portion. Then there is the cavity of the gills which is in continuation with the spaces mentioned above. Further on the connective tissue layer is very much reduced and near the tips of the secondary branches a thin connective tissue lining is all that remains (fig. 9). The cavity of these gills contains a large number of coelomic corpuscles, which shows that in the living animal the cavity contains coelomic fluid. The fluid in this portion of the gills would be separated from the surrounding water of the sea by the ciliated epithelium and the thin connective tissue layer only. The structure of the gill-like processes of *T. dendrorhynchus* and *T. sabinum* is very like that of *T. branchiorhynchus*, only they are less highly evolved.

Besides the sinuses or spaces described above there are three blood-vessels in the proboscis. The median dorsal (*D.v*) lies deep in the connective tissue, the two lateral ones (*L.v*) in the outermost of the sinuses. Each of these vessels has a distinct wall of its own, formed of an outer cubical epithelium, circular muscle-fibres and an internal endothelial lining. A few longitudinal muscle-fibres can also be distinguished lying internal to the circular layer, but they do not form a continuous sheath. The distribution and relations of the blood-vessels are described further on in the account of the blood-vascular system. It may, however, be mentioned that they form a definitely closed system, and there is no connection whatsoever between these blood-vessels and the coelomic spaces in the proboscis as was imagined by Greef (4), but denied by Spengel (13), and could not be seen by Reitsch (9).

In transverse sections of the proboscis the lateral nerve (*N.l*) of each side is seen lying outside the lateral sinus. The distribution of the nerves is treated at length in the account of the nervous system. The minute structure of the nerves is the same as in the other Echiuroids.

A few remarks regarding the function of the proboscis and the significance of the gill-like processes of these species may now be made.

Greef assigned to the proboscis the function of a lung. The blood in its vessels being separated from the water of the sea by a thin tissue could, according to him, be easily oxygenated; he also said that the proboscis was of use in the prehension of the food material, which it definitely siezed and rolled into the mouth. Of these functions the former one is not possible in the way Greef assumed, as there is no connection between the blood-vascular system and the sinuses of the coelomic fluid, while the blood-vascular system is situated at a much deeper level. There is, however, as will be explained further, a great probability of the coelomic fluid being aerated here. The second function of the prehension of the food material is considered by Spengel to be performed only by the cilia on the ventral surface of the proboscis and not by the structure as a whole. Schmarda assigns to the proboscis of *Bonellia viridis* the function of respiration. Rolando[1] remarks "es ist kein Anzeichen da, dass er ihm zum Athem oder als kieme diene." Embleton (3) is doubtful as to whether

[1] *Isis* von Oken 1, pl. V, figs. 1-5 (1823).

so important a function as that of respiration could be assigned to a structure, which on the slightest provocation is thrown off completely in *Echiurus pallasii*, and is absent in some of the species of the genus *Thalassema*, as *T. vergrande*, and in the aberrent genus *Saccosoma*.

From the structure of the proboscis of the three species described above, it would be seen that the large development of the sinuses is correlated with the development and evolution of the gills. A few sinuses of this type are figured by Embleton for *E. unicinctus* and the two lateral ones are of common occurrence in the various species of *Thalassema* and other genera of Echiuroids. It has also been shown that these sinuses are in open communication with the general body cavity and are continuous with the cavities of the gills; and further that they have no connection with the closed blood-vascular system. The presence of coelomic corpuscles in their cavity and the red colour in the living animals shows that the coelomic fluid is constantly passing through them. The coelomic fluid would undoubtedly be of great use in making the proboscis firmer, but the chief use of the sinus connections and the development of hollow gill-like outgrowths seems to be the aeration of the coelomic fluid, a function which was assumed by the authors noted above though in a different way. The ciliated cells would also be of use in wafting the food particles to the mouth. It may also be remarked here that no indication that the proboscis can be thrown off was observed in the living specimens of the three species here discussed.

The possession of gills by these forms was considered by Annandale and Kemp as being possibly a character of sufficient validity to separate them into a new genus, though this course was not adopted by them. In view of what has been stated above and the close general resemblance of the anatomy of this group to that of the other species of the genus *Thalassema* I am not disposed to separate them into a new genus, but these brackish water species form a distinct group, of which *T. dendrorhynchus* may be taken as the type.

Stephenson (14) in confirmation of Michaelsen's view considers the gill-like processes of the freshwater Oligochaeta of little value as characters of generic importance, owing to the great variation exhibited by these structures both as regards situation and even in different specimens of the same species. The learned author in the course of a conversation further remarked that this view may possibly have a more general application in the case of other groups of animals living under similar circumstances, a view with which I am in entire agreement.

In considering the meaning of the peculiarities of the proboscis in this group it is important to bear in mind that the three species live in peculiar but similar types of environment. *T. sabinum* has been found only in the Talé Sap on the east coast of Peninsular Siam. The Talé Sap is a shallow lagoon the water of which varies in salinity with tide and season and is always muddy. In the outer and intermediate parts of the lake to which the Echiuroid is probably confined, the specific gravity[1]

[1] All the specific gravities here cited have been corrected to a standard temperature of 15°C. See Annandale and Kemp, *Mem. Ind. Mus.* V, p. 17. (1915).

may vary from 1·002 to 1·0085 at the beginning of the dry season. The specimens of *T. sabinum* obtained by the "Skeat Expedition" were dredged from the bottom in which, as Dr. Annandale informs me, the mud is mixed with sand, while the specimen procured by Dr. Annandale in 1916 was from mud mixed with dead shells. The only specimens of *T. dendrorhynchus* yet known were collected in the Chilka Lake in dense mud from muddy water varying in specific gravity from 1·006 to 1·009. The type-specimen of *T. branchiorhynchus* came from the still denser mud and equally muddy water of a creek in the Gangetic Delta, the water of which had a specific gravity of only 1·006. Other specimens of this species have since been taken in mud-flats at Balasore on the coast of Orissa. This place may be said to be on the open sea, but it must be remembered that the waters of the upper parts of the Bay of Bengal are much less salt than those of most seas.

There seem to be three points, therefore, in which the natural surroundings of the three species of *Thalassema* are abnormal, *viz.* (i) the low salinity of the water, (ii) the fact that it holds a large amount of finely divided mineral matter in suspension, and (iii) the density of the mud in which they burrow. Very little precise information is as yet available as to the effect of change of salinity on the respiration of aquatic animals, but that it may have a very material effect is probable. In dense mud and very muddy water there must inevitably be increased difficulty in obtaining the necessary amount of oxygen.

Integument.—The appearance of the integument has already been referred to in the account of the external characters. Its histological structure exactly resembles that of the proboscis except for the following differences:—the cuticle is thinner and a distinct alveolar layer is present. In the epidermis the gland-cells are far numerous in the papillae and very few sensory cells can be distinguished. The cutis layer is very well developed and fills up the greater part of the basal portion of the papillae. The muscular layers are well developed and consist of an outer one of longitudinal, a middle one of circular and an innermost of oblique muscle-fibres. The innermost layer of the integument consists of peritoneal cells of the type seen in other species.

Alimentary canal.—No differences can be seen in this group from that of the other described species. A short account of it in *T. branchiorhynchus* is here given and it may be noted that but for the differences in the length of the various divisions it is similar in the three species.

The alimentary canal may be divided into three divisions—(i). Fore-gut from the mouth to the pre-intestinal constriction and consisting of pharynx, oesophagus, gizzard and crop. This portion of the alimentary canal is different from the following second portion in having the longitudinal muscular layer outside the circular and not inside it, as is the case in the second part. (ii) Gut proper or the intestine having the ciliated groove (*C.g*) ventrally, this in the middle portion of the intestine becomes separate from it and runs along ventral to it as the collateral intestine or siphon (*Si*). This portion is marked off from the last part by the caecum. (iii) Hind gut or rectum, which opens at the anus and has the anal vesicles opening into it.

The mouth opens into the broad pharynx (*P*) which is 28 mm. long and opens into the oesophagus (*Oe*). The oesophagus runs upwards and backwards forming a loop; then becomes straight to suddenly recurve backwards. It is 11–12 mm. long and is held in place by the mesenteries, the arrangement of which is the same as in other species of the genus. The gizzard (*G*), which follows, is 4 mm. long, leads straight back and lies to the right of the nerve-cord; from it the crop (*Cr*) leads to the pre-intestinal constriction, which is marked off by the vascular ring; the crop is a little more than 3 mm. long.

The middle part of the alimentary canal or the gut is very long in all the species. From the pre-intestinal constriction to the origin of the siphon (*Si*) or collateral intestine it measures about 13 cm., from the origin of the siphon to its union with the intestine it measures about 9 cm., and from the latter point to the pouch-like caecum (*Ca*) about 17 cm.

The last part of the alimentary canal, the rectum (*R*), measures 12 mm.

The foregut of *T. branchiorhynchus* is shown in fig. 11, and the whole of the alimentary canal as seen in a dissection of *T. sabinum*, in fig. 10.

I have nothing to add to the remarkably accurate account of the histology of the alimentary canal of *T. neptuni* given by Jameson.

Nervous system.—The nervous system in this group is essentially similar to that of other Echiuroids. The single nerve-cord (*Nc*) is a conspicuous structure extending from near the mouth to the anus in the mid-ventral line. In living specimens of *T. sabinum* and *T. branchiorhynchus*, and even in the preserved specimens of these species, it is quite easily seen through the skin. In *T. dendrorhynchus* in the preserved specimens only a faint streak is to be distinguished. The nerve-cord is not bound to the body-wall by mesenteries, but lies directly on the musculature. There are no nerve-ganglia. It gives off lateral branches from the lateral margins at irregular intervals on both sides (these branches are not shown in fig. 10), which, after running free for a short distance, penetrate the body-wall, in which they run parallel to the circular muscles. Near the mouth anteriorly at its end the nerve-cord is thickened into a triangular area, from which two branches arise. These branches are continued for a short distance on the sides of the pharynx and then enter the proboscis, where they continue as the lateral nerve (*N.l*) of each side to meet near the tip and form a large ganglionic mass. These lateral nerves give a large number of branches in the proboscis; some of these branches could be traced up to the ciliated cells but no direct connection was seen.

In trying to homologize these structures with those of an annelid like the earthworm it seems that the proboscis is the very much elongated prostomium and that the supra-oesophageal ganglion of the earthworm has shifted here to a position far forward in the proboscis, and that the two lateral nerves are the very much elongated circumoesophageal connectives; whilst the triangular area from which the nerves arise is the suboesophageal ganglion.

Regarding descriptions of the histological structure of the nerve-cord I have nothing to add to the descriptions of Spengel, Reitsch and Embleton in other Echiuroids.

Blood-vascular system.—There is a closed circulatory system as in the Echiuroidea generally. I give here a description of the system as it is to be seen in *T. branchiorhynchus* (fig. 11); in the other two species it is essentially similar except for the relative lengths of the various vessels. A few variations in the connections of the vessels were also met with in some specimens; but this feature, as was noted by Jameson, is not a character of any great importance.

In this description I will begin with an account of the so-called heart and then go on to a description of the other vessels and their relations. The heart (*H*) is only the partly swollen basal part of the dorsal vessel (*D.v*) and lies in front of the pre-intestinal constriction; the structure of this part is in no way different from that of the rest of the vessel. From the heart the dorsal vessel continues forwards; while it receives the two branches of the so-called neuro-intestinal vessel (*N.v*) which circle round the alimentary canal in the situation of the pre-intestinal constriction to open into the heart at its posterior end. The dorsal vessel continues forwards from the body into the proboscis as the median dorsal vessel of that structure; at the tip of the proboscis it bifurcates and the two branches, bending downwards, continue on either side as the lateral vessels (*L.v.*) of the proboscis. These lateral vessels unite near the base of the proboscis to form the ventral vessel (*V.v*). This vessel runs over the ventral nerve-cord, ending blindly at its tip a little distance from the posterior end. Very near its anterior end the vessel gives off either a single branch which bifurcates further on or two branches. These circle round the oesophagus to form the so-called 'muscle-ring' (*M.r*) of Spengel and then unite to divide once again into two branches, which as already described open into the heart after going round the alimentary canal in the region of the pre-intestinal constriction. This vessel with its forkings is known as the neuro-intestinal vessel.

I have nothing to add to the previous descriptions of the histology of the blood-vessels.

The course of blood in this system can not definitely be understood with the present state of our knowledge of these forms.

The *coelomic fluid*, which is probably of far greater importance in the physiology of the animal than the blood, fills up the whole of the body cavity and the spaces in the proboscis described above. It contains a large number of coelomic corpuscles of the same nature as have been described for other species.

Segmental organs.—These organs have been designated by various names—Nephridia, anterior nephridia, brown tubes, genital pouches, segmental organs, etc. Of all these names segmental organ seems to be the most appropriate both from the point of view of structure and homology, and is adopted here.

In the group of species under consideration there are two pairs of these structures (*S.o*) lying on the ventral surface one behind the other, a pair on either side of the nerve-cord opening to the exterior behind the level of the hooks.

Each segmental organ (fig. 12) consists of a vesicle (*V.*), which differs slightly in shape in the three species, but is rather narrow and elongated, tapering to a blunt apex in all. The opening to the exterior is at the base, while the internal opening or that of the funnel (*F*) lies on the upper surface a little above the point of attachment.

The funnel is often described with a pair of long spirally coiled arms arising from its sides. On comparing the funnel of these species with that of a species like *T. neptuni* or *Bonellia viridis*, where it is simple, we find that in species with the spirally coiled arms only the lateral margins of the funnel have become very much elongated and in the preserved specimens lie in a cork-screw spiral. The structure of the arms is exactly like that of the other portions of the funnel and the elongation seems to be an arrangement for providing an increased ciliated surface. In stained and mounted specimens of the segmental organs, the anterior and posterior borders of the funnel lie close together, and the elongated lateral margins lie as the coiled arms. The number of coils varies in different species and even in different specimens.

Sections near the base of the vesicle (fig. 13) show an internal lining of much elongated columnar cells, outside it are two distinct bands of muscle-fibres, which run in an oblique direction and are in continuation with the muscles of the body-wall; a few connective tissue fibres are also to be seen with the muscle-fibres and there is the outermost layer of peritoneal cells (*Pe*). Sections taken higher up through the vesicles, show a regular decrease of the muscle-fibres and the connective tissue, until near the tip only a thin layer of connective tissue separates the peritoneal from the inner cells. In the inner cells also a regular series from the long columnar to the cubical form can be traced from below upwards. The funnels have a lining of ciliated cells, the cilia of which work inwards. A transverse section of the spirally-wound arms (fig. 14) shows the inner layer of ciliated cells, then a few muscle and connective tissue fibres and the outermost layer of peritoneal cells (*Pe*).

The contents of these organs were a larger number of coelomic corpuscles and a few eggs. They perhaps serve both as nephridia and as the efferent ducts for the reproductive elements.

Anal vesicles.—These structures like the segmental organs have received different names from various authors, some of these are,—anal vesicles, posterior nephridia, anal trees, anal glands, anal gills, etc. The name anal vesicles in the present state of our knowledge of their function seems to be the most suitable, and is the one used in this paper.

The structures are very similar in *T. dendrorhynchus* (fig. 16) and *T. branchiorhynchus*, except that they are rather longer in the latter species. I quote here the description of the anal vesicles of *T. dendrorhynchus* from the description of Annandale and Kemp (2). "The anal trees are short and simple, nearly half the length of the body in a contracted specimen. They have a slightly brownish tinge and the walls are very thin; the distal extremity is narrowly cylindrical, but the apex is blunt, the basal or proximal part is somewhat swollen, but there is no definite vesicle. No funnels are visible with the aid of a hand-lens and there are no muscular strands attaching the organ to the body-wall. Examined under the microscope, each tree is seen to possess two longitudinal rows of ciliated funnels, the mouth of which does not exceed 0·047 mm. in breadth, while the length is not greater than 0·168 mm. The two trees open separately into the intestine close to the anus."

The vesicles open ventro-laterally. Their histological structure and probable function is treated at length further on.

Lanchester in his description of the anal trees of *T. sabinum* says that they are short. In the specimen before me they measure 2·2 mm. in length, nearly one fifth of the total length of the animal. In the living specimen they were tinged with yellow, while in the preserved condition they are of a creamy colour. The shape of these is shown in fig. 15. The funnels on the vesicles are not restricted to two lines as in the other two species, but their number is very much larger and they are arranged in a number of rows on the distal half or so. The funnels (fig. 15*a*) are much smaller than those of the other two species, being 0·076 mm. in length and the mouth 0·051 mm. in greatest breadth.

The wall of the vesicle is formed largely by flattened epithelial cells though a few muscle-fibres can also be distinguished here and there. The boundaries of the cells can not be distinguished in all cases. The protoplasm of the cells is granular and surrounds the rather small circular nucleus. The cells on the margins of the funnels and also on their walls are ciliated. The cilia are directed inwards and from the direction of their insertion it seems that they can work only inwards. Without going into details regarding the histology of the rectal portion of the intestine and the point where the anal vesicles open into it, it may be mentioned that the tissues are of the same nature as mentioned by Embleton (3) and Spengel (13). I could not find any ciliated cells lining the openings of these vesicles into the rectum as are mentioned by Jameson for *T. neptuni* (6) and by Greef (4). The latter author has also described a special system of blood-vessels in the vesicle wall; these vessels are according to Embleton not present in *E. unicinctus* and I have found no trace of them in my preparations; and further there is no part of the blood-vascular system from which these blood-vessels could be given off as the dorsal blood-vessel does not extend so far back and the ventral one is solid in this region. Probably this special arrangement of the blood-vessels and the ciliated openings of these anal gills, as he terms them, led Greef to assign a respiratory function to these structures, which he considered to be analogous with the respiratory trees of the Holothurians. Schmarda[1] and Forbes and Goodsir also held the same opinion. The structure of the vesicles, however, as I have interpreted it, does not permit this function to be assigned to these organs. The direction of the cilia in the funnels would not allow any fluid from the vesicles to enter into the body cavity. The contents of the vesicles are, moreover, coelomic corpuscles in various stages of degeneration, and not mud or sand such as would naturally be taken in with the incoming water from the rectum. The question of anal respiration in these forms has not received the attention it deserves and I am unfortunately not in a position at present to clear up the doubtful points.

The structure and contents of the vesicles point on the other hand to an excretory function, a function which has also been assigned to them by Huxley,

[1] *Mem. Acad. Vienna*, Vol. II, pls. iv-vii (1852).

Gegenbaur, Claus, Hatschek, Korschelt and Heider, Shipley and others on both morphological and embryological grounds.

I have nothing special to add regarding the structure of the reproductive organs of these species.

SUMMARY.

To sum up, therefore, the three species of Echiuroids found up to the present in brackish waters connected with the Indian Ocean agree in general structure with several species of the genus *Thalassema*, Gaertner, from which I see no reason to separate them generically. They form, however, a very distinct group in the genus and possess certain peculiarities in the structure of the proboscis which are probably correlated with their mode of life. It is impossible to say, with our present knowledge, what factor in their environment is of more importance in reference to their structural modifications, and it may be that life in dense mud and muddy water, and the danger of partial desiccation, as Dr. Annandale has pointed out in dealing with the Hydrozoa in this volume, are factors of more importance than change of salinity in the water.

DESCRIPTION OF A NEW MARINE SPECIES OF THALASSEMA.

Thalassema kempi, sp. nov.

A single specimen of this interesting species was collected by Mr. S. W. Kemp, Superintendent, Zoological Suvey of India, on the reef at the north end of Ross Island near Port Blair in the Andamans, on the 20th of February, 1915. I have very great pleasure in associating this new species with the name of my friend Mr. Kemp, who has done so much towards increasing our knowledge of the Marine Fauna of the Indian seas.

FIG. 2.—*Thalassema kempi*, sp. nov. Ventral view of the type-specimen.

The body as seen in text-figure 2, is cylindrical, thicker in the middle and gradually tapering to the two ends. It measures 7·7 cm. in length and 2·1 cm. in maximum breadth in the preserved specimen. The proboscis is short and stumpy, and slightly truncated at its anterior end; it measures 1·7 cm. in length. The colour of the preserved specimen is yellowish. The whole of the proboscis and the body are covered with papillae, which are very minute and just visible on the proboscis. On the body the papillae are small anteriorly, gradually increasing in size to the posterior end, where they are very large ; a few large ones are also found scattered in between the smaller ones over the whole surface. Two hooks of a golden yellow colour, are present ventrally behind the mouth in the usual situation. The muscles of the body-wall, specially in the middle region, are broken up into twenty distinct bundles. There are four pairs of segmental organs, the lateral margins of the funnels of which are elongated into spirally-coiled lobes. The segmental organs are situated posterior to the level of the ventral hooks, the first two pairs are rather poorly developed and the fourth pair is the best developed of all. The anal vesicles are of a light yellowish tinge, very much contracted in the specimen and about one third of the length of the animal.

Type specimen in the collection of the Zoological Survey of India (Indian Museum) No. W $\frac{194}{1}$.

The species differs from all those previously described in having four pairs of segmental organs, in the number of muscle bands and in the general arrangement of the papillae on the surface.

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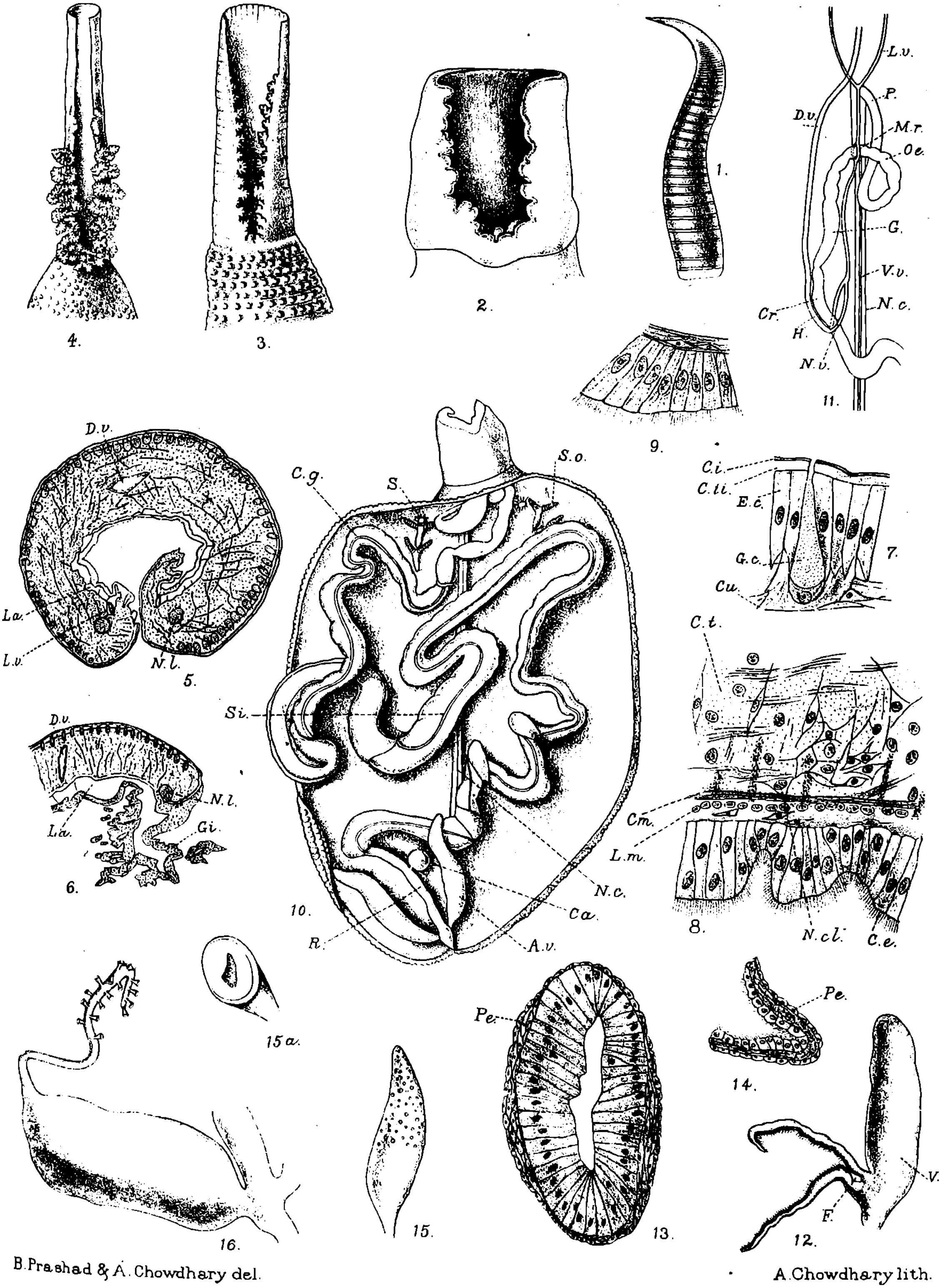
EXPLANATION OF PLATE XI.

FIG. 1.—Seta of *T. branchiorhynchus*, lateral view.
,, 2.—Proboscis of *T. sabinum*, ventral view. × 20.
,, 3.—Proboscis of *T. dendrorhynchus*, ventral view. × 3.
,, 4.—Proboscis of *T. branchiorhynchus*, ventral view. × 3.
,, 5.—Transverse section of the proboscis of *T. dendrorhynchus*, as seen with the low power of the microscope.
,, 6.—Half of a transverse section of the proboscis of *T. branchiorhynchus* in the gill-bearing region; same magnification as in fig. 5.
,, 7.—Epithelial and other layers on the dorsal surface of the proboscis of *T. branchiorhynchus* as seen with the $\frac{1}{12}''$ oil immersion lens.
,, 8.—Epithelial and other layers on the ventral surface of the proboscis of *T. branchiorhynchus*, same magnification as in fig. 7.
,, 9.—Wall of the gill-like processes of *T. branchiorhynchus*, same magnification as in fig. 7.
,, 10.—Dissection of *T. sabinum* to show the general anatomy; the mesenteries, lateral branches of the nerve-cord, and the blood-vessels not shown.
,, 11.—Blood-vascular system and fore-gut of *T. branchiorhynchus*.
,, 12.—A segmental organ of *T. branchiorhynchus* as seen in a side view.
,, 13.—Transverse section of the vesicle of segmental organ of *T. branchiorhynchus* near the external opening.
,, 14.—Transverse section through one of the spiral prolongations of the funnel of *T. branchiorhynchus*.
,, 15.—Anal vesicles of *T. sabinum*.
,, 15*a*.—One of the funnels of the anal vesicle of *T. sabinum*. × 250.
,, 16.—Anal vesicle of *T. branchiorhynchus* showing the relation with the rectum.

REFERENCE LETTERING.

A.v., Anal vesicle. *Ca.*, Caecum. *C.i.*, Outer layer of the cuticle. *C.ii.*, Inner layer of the cuticle. *C.e.*, Ciliated epithelium. *C.g.*, Ciliated groove of the mid-gut. *C.m.*, Circular muscles. *Cr.*, Crop. *C.t.*, Connective tissue. *Cu.*, Cutis. *D.v.*, Dorsal blood-vessel. *E.c.*, Columnar epithelium. *G.*, Gizzard. *Gi.*, Gills. *G.c.*, Gland cells. *H.*, Heart. *La.*, Lacunar spaces in the proboscis. *L.m.*, Longitudinal muscles. *L.v.*, Lateral blood-vessel. *M.r.*, Muscle ring. *N.c.*, Nerve cord. *N.cl.*, Nerve cell. *N.l.*, Lateral nerve of the proboscis. *N.v.*, Neuro-intestinal loop of the blood-vessels in the region of the pre-intestinal constriction. *Oe.*, Oesophagus. *P.*, Pharynx. *Pe.*, Peritoneal layer of cells. *R.*, Rectum. *S.*, Setal end seen from within. *Si.*, Siphon. *S.o.*, Segmental organ. *V.*, Vesicle of the segmental organ. *V.v.*, Ventral vessel.



B. Prashad & A. Chowdhary del. A. Chowdhary lith.

ORIENTAL ECHIUROIDEA OF BRACKISH WATER.

Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

LES ORTHOPTÈRES CAVERNICOLES DE BIRMANIE ET DE LA PENINSULE MALAISE.

par L. CHOPARD, *Licencié ès Sciences.*

CONTENTS.

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Planches XII à XIV.

INTRODUCTION.

C'est à L. Fea que l'on doit la découverte des premiers Orthoptères cavernicoles provenant des grandes grottes des environs de Mulmein. De son voyage en Birmanie il rapporta en 1889 un *Paradiestrammena* et un Blattide (*Spelaeoblatta gestroi* Bol.), tous deux nouveaux pour la science. Ce n'est qu'une dizaine d'années plus tard, en 1908, que W. F. Kirby fit connaitre une autre espèce de *Paradiestrammena* découverte par Mr. N. Annandale à qui elle fut dédiée.

Les explorations méthodiques entreprises depuis cette époque par Mr. Annandale et Mr. Gravely ont élargi nos connaissances sur cette faune cavernicole si intéressante et je suis à même aujourd hui, de publier l'étude détaillée de 11 espèces d'Orthoptères cavernicoles appartenant à 7 genres différents.

La plupart de ces espèces sont représentées par de nombreux exemplaires, surtout en ce qui concerne celles appartenant au genre *Paradiestrammena* ; d'autres, par contre, semblent rares et n'ont été rencontrées qu'une seule fois malgré des explorations répétées. Il est donc probable que la faune des grottes de la Birmanie et de la péninsule réserve encore de nombreuses surprises et elle ne pourra être considérée comme bien connue qu'après des années de recherches assidues.

Cette faune ne présente pas de caractères trés marqués; les espèces qui la composent, exception faite de *Spelaeoblatta gestroi* Bol., sont toutes fort voisines de formes lucicoles à tendances obscuricoles et ne montrent que des caractères adaptatifs de peu d'importance, portant surtout sur le système de pigmentation. Il est à noter cependant que le genre *Paradiestrammena*, qui est le plus riche en espèces et en individus dans les grottes, ne contient actuellement aucune espèce lucicole dans la Péninsule malaise. Par contre, les *Rhaphidophora* présentent, dans la jungle, des formes presque identiques aux formes cavernicoles et qui sont peut-être appelées, étant donnés leur habitat et leurs moeurs, à se rencontrer, accidentellement ou non, dans les cavernes.

Qu'il me soit permis, en terminant, de remercier Mr. N. Annandale, Director, Zoological Survey of India, et Mr. F. H. Gravely, d'avoir mis à ma disposition les riches collections de l'Indian Museum.

DISTRIBUTION DES ESPÉCES.

Quelques-unes des espèces se rencontrent dans des grottes différentes et assez éloignées ; par contre la plupart se montrent très localisées et leur habitat est restreint à une seule grotte. Cette distribution géographique se trouve résumée ci-dessous :

ASSAM.

Maosmai Cave.—*Paradiestrammena brevifrons* Chop.

KAREN-NI.

Caverne de Jado.—*Spelaeoblatta gestroi* Bol.

JALOR.

Goah glap.—*Chelisoches morio* Fab., *Phyllodromia nigrocincta* Chop., *Periplaneta cavernicola* Chop., *Leucophaea striata* Kirby, *Paradiestrammena annandalei* Kirby, *Paradiestrammena gravelyi nigricauda* Chop.

TENASSERIM.

Farm Caves, near Moulmein.—*Rhaphidophora mulmeinensis* Chop., *Paradiestrammena feai* Chop.

Dhammathat.—*Paradiestrammena feai* Chop.

SELANGOR AND PERAK.

Lenggong Caves.—*Paradiestrammena gravelyi* Chop.

Batu Caves.—*Chelisoches morio* Fab., *Miroblatta silphoides* Chop., *Leucophaea striata* Kirby, *Paradiestrammena gravelyi* Chop.

Langkawi Id.

Rhaphidophora cavernicola Chop.

CEYLON.

Paradiestrammena gravelyi ceylonica Chop.

ETUDE SYSTEMATIQUE DES ESPECES.

DERMAPTERA.

Fam. CHELISOCHIDAE.

Gen. **Chelisoches**, Scudder.

Chelisoches morio, Fabr.

Batu caves near Kuala Lumpur (*N. Annandale*, 2-i-16) under stones on floor, at entrance to caves. 2 ♂, 2 ♀ adultes, 1 ♂ immature.

Jalor caves. Cité par Annandale, Brown et Gravely (1913, p. 405).

HABITAT.—Cette espèce est lucicole et très répandue dans la région indienne et indo-malaise.

Bien que les individus rencontrés dans les grottes ne diffèrent aucunement de ceux capturés à l'air libre, cette espèce peut être considérée comme cavernicole; elle a en effet été trouvée á plusieurs reprises et dans des grottes différentes ; d'autre part le matériel recueilli par Mr. N. Annandale contient un jeune individu ayant encore deux mues à subir, ce qui semble indiquer que l'espèce se reproduit dans la grotte.[1]

ORTHOPTERA.

Fam. BLATTIDAE.

Subfam. *PHYLLODROMIINAE*.

Gen. **Phyllodromia**, Serville.

Phyllodromia nigrocincta, n. sp.

Pl. XII, figs. 1-3.

Goah Glap, Bukit Tapang, Biserat (*N. Annandale*, 4-ii-16); on the walls of the inner cavern[2] of cave. 3 ♀.

Espèce de taille moyenne, très allongée de forme, jaune testacé, à pronotum plus foncé bordé tout autour d'une assez large bande noire ; pattes et antennes concolores. Pubescence presque nulle.

TÊTE.—Tête petite et large, à sommet presque droit ; occiput convexe, marqué d'une ligne claire médiane, formant avec le vertex un angle très arrondi ; vertex bombé, présentant deux lignes de 7 à 8 pores pilifères assez régulières, la supérieure arquée, l'inférieure droite ; front et écusson facial bombés, testacés, portant quelques poils rares. Clypéus très large, à limite supérieure indécise, bords latéraux un peu convexes, bord inférieur droit, sa moitié inférieure blanchâtre ; labre large, très court, à bord apical aminci et un peu échancré au milieu.

Yeux noirs, à facettes petites, échancrés en avant le long de la fossette antennaire, s'élargissant dans leur moitié supérieure dont le bord est arrondi, moitié inférieure étroite, arrondie à l'extrémité. Taches ocellaires blanches, assez grandes, ovales, situées entre l'oeil et la partie supérieure de la fossette antennaire ; vers le milieu de cette fossette, se trouve une petite inpression ronde, concolore, qui doit être un organe sensitif.

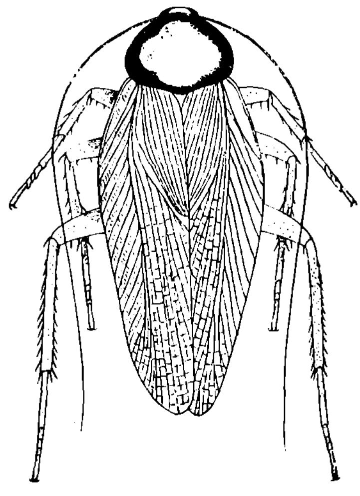

FIG. 1.—*Phyllodromia nigrocincta*, n. sp. Femelle, × 4.

Antennes plus longues que le corps, testacées, très claires vers l'apex, de 95 articles environ ; 1er article assez long, un peu dilaté, presque glabre, 2e environ

[1] [*C. morio* is much commoner in Malaya than in India. It is nocturnal in habits and breeds under stones in the open as well as in caves. *N. A.*]

[2] [This is the cavern I described in *Ent. Records*, XII, p. 75 (1900). Its walls were covered in places with *Phyllodromia nigrocincta*, *Periplaneta cavernicola and Chelisoches morio*, the *Periplaneta* being particularly abundant, while the floor, chiefly composed of bat's guano, literally heaved with *Leucophoea striata*. *N. A.*]

deux fois plus long que les suivants, 3e un peu plus long que le 4e, celui-ci très court, cylindrique; à partir du 25e environ, les articles commencent á s'allonger, deviennent moniliformes puis très allongés, un peu élargis au sommet; jusqu'au 12e les articles sont presque glabres, luisants; ils sont ensuite couverts d'une fine pubescence et portent quelques soies apicales.

Pièces buccales très courtes et relativement faibles; mandibules larges, à bord externe très convexe, bord interne brunâtre, armé de dents tranchantes, au nombre de 3 à la mandibule droite, 4 à la mandibule gauche; la dent médiane est très forte aux deux mandibules et l'inférieure est terminée par un talon tranchant.

Langue étroite, ne dépassant guère les mandibules, un peu échancrée á l'apex.

Maxilles très larges à la base, s'écartant beaucoup de chaque côté du basilaire; lacinias et galeas très courts, les premiers armés de deux fines dents apicales, à bord interne presque droit, garni de longues soies, les seconds larges à l'apex, enveloppant les lacinia et les dépassant un peu en longueur. Palpes courts, à articles I et II très courts, le premier globuleux, le second dilaté à l'apex, III long, assez grêle, un peu incurvé, IV un peu plus court que III, assez fortement dilaté à l'apex, V égal à III, triangulaire, subaigu à l'apex, à bord supérieur droit; pubescence assez abondante, surtout sur les derniers articles.

Labium très court et large; basilaire très large, à bords externes fortement convexes; mentum court, à bord antérieur droit; palpigère presque deux fois aussi large que long, profondément divisé au milieu; lobes très courts, les externes arrondis, à pubescence assez longue, les internes assez larges à la base, triangulaires. Palpes courts, à article I très court, dilaté à l'apex, II un peu plus long, cylindrique, III presque égal aux deux premiers réunis, assez grêle, un peu incurvé, arrondi à l'apex.

THORAX.—Pronotum large, de couleur testacé roussâtre avec une bordure presque noire, irrégulière, très large sur les côtés, étroite en avant et en arrière; surface déprimée, marquée d'une ponctuation très écartée, à pubescence rare; bords finement rebordés, le bord antérieur très largement arrondi, bord postérieur sinué; angles postérieurs arrondis.

Mésonotum court, à bord postérieur un peu convexe; métanotum deux fois aussi long que le mésonotum, à bord postérieur presque droit, présentant une petite impression de chaque côté de la ligne médiane; bord postérieur du méso-, et du métanotum présentant une membrane libre très courte, anguleuse au milieu, sinuée sur les côtés.

Dessous du thorax à pièces sclérifiées presque nulles, les hanches des trois paires étant contiguës sur la ligne médiane. Episternes et épimères prothoraciques très réduits, formant deux bourrelets presque membraneux, en avant desquels se trouvent de volumineuses pièces jugulaires; au méso- et au métathorax, les épisternes sont très grands, élargis, formant une grande plaque noirâtre, divisée par un sillon oblique; épimères formant un bourrelet brun noirâtre.

ABDOMEN.—Abdomen un peu déprimé, testacé en dessus, roussâtre en dessous, avec une petite bordure latérale brune, surtout apparente sur les tergites. Ceux-ci sont imbriqués, à pubescence rare; le 1er est assez long, à bord postérieur très convexe, les suivants jusqu'au 7^e ont leur bord postérieur presque droit, un peu sinué sur les côtés ; 8^e et 9^e très courts, le dernier un peu convexe ; 10^e brunâtre, assez petit, arrondi et légèrement échancré à l'apex. Sternites à bord postérieur assez fortement concave jusqu'au 6^e, le 1er étant nul ; 7^e formant la plaque sous-génitale assez grande, tronquée au sommet avec les angles très largement arrondis. Les stigmates sont placés à la face inférieure du bord libre des tergites, près de la base, sauf sur le 8^e tergite qui, étant très court, porte le stigmate près de son extrémité.

Valves anales brun noirâtre, arrondies, à bord apical aminci, lamellaire.

Cerques assez longs, de 12 articles courts vers la base, plus allongés ensuite ; leur face supérieure est un peu déprimée, glabre, face inférieure arrondie, pubescente.

OVISCAPTE.—Oviscapte à peine long d'un millimètre, caché sous le 7^e sternite dont deux replis de la face interne viennent embrasser sa base. Valves supérieures et inférieures presque membraneuses, arrondies à l'apex ; valves internes sclérifiées, aiguës. Le 9^e sternite forme un arc chitineux aux extrémités duquel sont articulées les valves supérieures, le 8^e sternite est en grande partie membraneux, sauf une plaque transversale réunissant la base des valves inférieures ; cette plaque s'unit, par ailleurs, aux replis de la face interne du 7^e sternite qui sont en partie sclérifiés.

PATTES.—Pattes antérieures assez grêles ; hanches allongées, étroites, à face antéro-interne fortement convexe, un peu luisante, couverte de poils roux courts et espacés ; face externe profondément creusée en gouttière, blanchâtre, glabre ; bord antéro-interne comprimé, faiblement dilaté en lame vers l'extrémité ; lobes apicaux arrondis, peu saillants. Trochanters courts, pubescents. Fémurs comprimés, assez grèles, à pubescence courte et espacée, à face supérieure arrondie, face inférieure sillonnée ; apex armé de deux épines internes dont la supérieure, insérée vers le milieu du bord apical, est très longue et un peu courbe, l'inférieure un peu plus courte et droite, et d'une épine externe inférieure, médiocre ; bord inférieur interne portant une rangée de 14 à 15 épines jaunâtres, assez irrégulières, les 3 premières et la dernière beaucoup plus longues que les autres ; bord externe portant seulement 2 petites épines, 1 vers le milieu et 1 près de l'apex, et 2 assez fortes soies entre ces épines. Tibias assez forts, un peu plus courts que les fémurs, velus, armés de 4 épines apicales dont les 2 supérieures un peu courbes, les inférieures droites, 3 épines supérieures (2 médianes, 1 externe) et 3 inférieures (2 externes, 1 interne) ; toutes ces épines sont fines, testacées, sillonnées en dessous et très finement serrulées sur leurs bords inférieurs. Tarses assez courts, à métatarse un peu plus long que les trois articles suivants réunis, un peu comprimés et élargis à l'apex ; 2^e article un peu plus long que les deux suivants, mais cependant très court ; les 4 premiers articles pubescents, armés en dessous de deux rangées de fines spinules et d'une spinule semblable au milieu du bord apical ; 5^e, article cylindrique, grêle, presque droit ; griffes fines ; pelotte tronquée au sommet.

Pattes intermédiaires : hanches larges et comprimées, noirâtres à la base de la face supéro-interne qui est un peu concave, glabre ; face inférieure étroite, convexe, éparsément ponctuée et pubescente ; bord supéro-externe court, peu saillant, terminé par un lobe arrondi, assez étroit ; bord supéro-interne lamellaire, large et presque noir à la base. Fémurs assez larges, comprimés, à bord supérieur convexe et arrondi, armés à l'apex de 2 épines externes assez longues, courbes; leurs bords inférieurs portant 4 à 5 épines assez faibles et irrégulières; face externe présentant, vers le quart supérieur, un sillon garni de poils roux. Tibias assez épais, pubescents, armés de 4 épines apicales assez longues, droites, 8 épines supérieures (3 externes, 3 médianes, 2 internes) et 6 inférieures (3 externes, 3 internes). Tarses grêles, un peu comprimés, à pubescence courte, presque spinuliforme, les 4 premiers articles très finement serrulés en dessous; métatarse égal aux autres articles réunis; 5[e] article cylindrique, grêle.

Pattes postérieures: hanches et fémurs presque semblables aux intermédiaires; hanches très larges à la base, fémurs à bord supérieur assez fortement convexe, armés de 2 épines apicales externes et de 4 à 5 petites épines sur chaque bord inférieur. Tibias longs, assez forts, armés de 4 épines apicales, 13 supérieures (5 externes, 5 internes, 3 médianes) et 10 inférieures (5 externes, 5 internes); l'épine apicale inférieure interne est la plus longue de toutes. Tarses très allongés, à métatarse égalant l'ensemble des autres articles.

Elytres et ailes.—Elytres très étroits, plus longs que l'abdomen, jaune testacé dans la moitié antérieure, transparents vers le bord interne; bord antérieur convexe près de la base, presque droit, ensuite jusqu'à l'extrémité; bord interne presque droit, apex arrondi. Veine discoïdale plus marquée que les autres, située presque au milieu de l'élytre, divisée vers sa moitié, le rameau inférieur deux fois redivisé, le tronçon basal et le rameau supérieur portant environ 18 branches assez régulières et un peu sinuées; veine médiane bifurquée très près de la base et portant 5 á 6 rameaux parallèles entre eux, très allongés. Les espaces internervaires sont occupés par des veinules assez espacées et quelques fausses nervures, dans la partie apicale seulement; le champ antérieur ne présente ni ponctuation ni nervules. Champ anal étroit et allongé, présentant 6 nervures parallèles, à intervalles lisses.

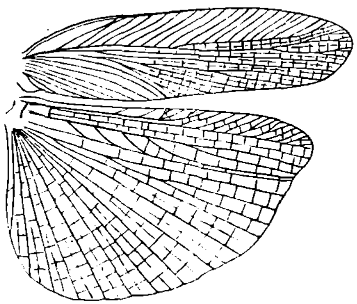

Fig. II.—*Phyllodromia nigrocincta*, n. sp. Nervation de l'aile et de l'élytre droits, × 4.

Ailes très larges, transparentes sauf vers l'extrémité du bord antérieur qui est jaunâtre; champ antérieur étroit, échancrure anale peu marquée. Veine médiastine à 2 ou 3 rameaux; médiane à 9-10 rameaux dont quelques-uns divisés; ulnaire antérieure simple; ulnaire postérieure bifurquée vers le tiers apical et portant, dans la partie basale, 4 rameaux incurvés, le dernier atteignant le bord externe; champ apical très faiblement mais visiblement marqué; champ postérieur présentant une dizaine de nervures dont la 1[re] quatre fois divisée. Nervules assez peu marquées et espacées.

Dimensions.—Les trois individus de cette espèce que j'ai examinés sont de taille semblable; leurs principales dimensions sont les suivantes:

Long. avec les élytres ..	17·5 mm.	Tibia ant. ..	2·2 mm.
„ du pronotum ..	3·5 mm.	Fémur interm. ..	4 mm.
Elytres	13·5 mm.	Tibia interm. ..	3·5 mm.
Ailes	12 mm.	Fémur post. ..	4 mm.
Fémur ant. ..	3 mm.	Tibia post. ..	5·5 mm.

Cette espèce présente un faciès très particulier qui permet de la reconnaître très, facilement ; la coloration du pronotum est très caractéristique.

Subfam. *BLATTINAE*.

Gen. **Periplaneta,** Burmeister.

Periplaneta cavernicola, n. sp.

Pl. XII, figs. 4–9.

Goah Glap, Bukit Tapang, Biserat (*N. Annandale*, 4-ii-16) ; on walls of inner caverns. 27 individus ♂, ♀ et jeunes.

Grande espèce de couleur brun roux foncé, uniforme, un peu plus claire en dessous. Pubescence nulle en dessus, rare et courte en dessous ; ponctuation assez fine, nulle sur le thorax. Pattes et antennes concolores.

TÊTE.—Tête petite, à sommet très arrondi ; occiput court, faiblement ponctué. Face très allongée, plus claire que la partie supérieure, présentant une rare pubescence dressée ; front étroit, un peu rembruni avec deux lignes longitudinales plus foncées, peu marquées, présentant une ponctuation assez forte mais très espacée ; écusson facial large, peu bombé à ponctuation presque nulle, ridé dans sa partie inférieure ; joues lisses, bombées, anguleuses au bord externe, limitées au bord interne par un sillon profond ; clypéus à bord inférieur un peu concave, à peine plus court que le bord supérieur, les angles inférieurs très arrondis, l'ensemble environ trois fois plus large que haut, à partie supérieure plus foncée que la partie inférieure, laquelle présente un petit sillon médian ; labre assez large, incisé à l'apex, blanchâtre à la base et vers l'apex, à ponctuation assez fine, irrégulière, parsemée de quelques gros pores pilifères dont 6 forment deux lignes submédianes.

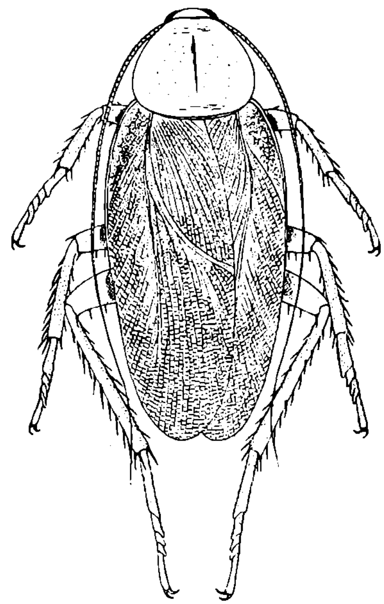

FIG. III.—*Periplaneta cavernicola*, n. sp. Femelle. × 2.

Yeux noirs, allongés, à facettes fines, leur moitié inférieure, derrière la fossette antennaire, est étroite, à bords parallèles, bord inférieur arrondi ; leur moitié supérieure s'élargit beaucoup, contournant la fossette antennaire sur le front, et formant un angle supérieur presque droit et un angle inférieur très arrondi. Taches ocellaires blanches situées sous le bord inféro-interne de l'oeil, entre celui-ci et la fossette antennaire contiguës à l'un et à l'autre.

Antennes rousses, dépassant la longueur du corps, de 140 articles environ, devenant plus claires vers l'extrémité ; 1^{er} article assez grand, dilaté, presque glabre, lisse, 2^e très court, un peu dilaté au sommet, 3^e long, cylindrique, également lisse et presque glabre, articles suivants cylindriques très courts à pubescence devenant petit à petit plus abondante ; à partir du 40^e environ, les articles s'allongent peu à peu, jusqu'à devenir au moins quatre fois plus longs que larges ; leur pubescence devient abondante, rousse, formée d'une pubescence foncière couchée et de longs poils apicaux ; près de l'extrémité de l'antenne, les articles se raccourcissent un peu mais conservent les mêmes caractères.

Pièces buccales : mandibules très fortes, à bord interne noirâtre, armé de deux grandes dents apicales tranchantes et d'une dent médiane triangulaire, aigue, suivie d'un talon tranchant ; cette dent est beaucoup plus forte à la mandibule gauche qu'à la droite.

Hypopharynx étroit, atteignant à peine l'apex du labium, à face supérieure un peu carénée.

Maxilles à pièces basilaires allongées, étroites, angle externe un peu arrondi ; lacinias allongés, à bord externe presque droit, bord interne assez fortement convexe dans la partie portant le peigne ; cette partie se termine par un brusque rétrécissement, après une dent subapicale modifiée, un peu aplatie et terminée par un bord noirâtre, faiblement denticulé et recourbé en dessous[1] ; apex armé de deux dents noirâtres, aiguës ; galeas plus longs que les lacinia, repliés en gouttière à l'apex. Palpes assez courts, à articles I et II très courts, un peu dilatés à l'apex, III allongé, assez grêle, un peu incurvé en dedans, IV un peu plus court que III, arrondi, assez fortement dilaté à l'apex, V égal à III, étroit, à apex subaigu, bord supérieur un peu concave, bord inférieur court, formant un angle arrondi avec le bord apical tronqué droit ; pubescence rare sur les trois premiers articles, plus abondante sur les deux derniers qui sont un peu rembrunis.

Labium à pièce basilaire large, à bords latéraux sinués, bord antérieur concave ; mentum très court, un peu plus étroit que le basilaire, à bord antérieur droit ; palpigère un peu plus long que large dans son ensemble, divisé presque jusqu'à sa base ; lobes courts, externes larges, à bord externe fortement convexe, les internes très petits, triangulaires. Palpes assez longs, à articles I et II courts, subégaux, le premier un peu dilaté à l'apex, III un peu plus long que les deux premiers réunis, cylindrique, à peine dilaté à l'apex. Pubescence rare sur les pièces du labium, un peu plus abondante sur les palpes.

THORAX.—Pronotum large, déprimé, à surface presque lisse, présentant seulement

[1] Ce petit organe, assez curieux, a été décrit tout récemment, chez *P. americana* L. et *P. australasiae* Fab., par M. le Pr. E. Bugnion qui y voit un organe de préhension de l'antenne dans l'acte du nettoyage ; il ne me semble pas douteux, en tout cas, qu'il s'agisse d'une dent antéapicale modifiée. (*Cf.* E. Bugnion : Les pièces buccales de la Blatte, in Bull. Soc. ent. Suisse, XII [1916], pp. 383–400, pl. 25).

quelques ponctuations éparses et quelques rides près des bords antérieur et postérieur, ligne médiane très faiblement et obtusément carénée. Bord antérieur légèrement échancré au milieu, très largement arrondi latéralement; angles latéraux très arrondis; bord postérieur presque droit; les bords antérieur et postérieur très finement rebordés.

Mésonotum assez court, à surface lisse, faiblement caréné au milieu; bord postérieur assez largement arrondi, présentant une membrane libre très courte.

Métanotum un peu plus long que le mésonotum à disque uni, lisse; bord postérieur tronqué droit, ne présentant pas de membrane libre mais à angles postérieurs prolongés par une étroite languette membraneuse.

Dessous du thorax à pièces sclérifiées testacées, presque glabres, très peu développées par suite du rapprochement des hanches sur la ligne médiane.

Prosternum présentant seulement une petite pièce médiane allongée et des pièces latérales en V contournant l'insertion de la hanche antérieure; en avant de lui, se trouvent quatre très volumineuses pièces jugulaires formant un collier complet. Episternes et épimères petits, formant deux pièces latérales séparées par un profond sillon.

Mésosternum présentant une petite pièce arrondie postérieurement; métasternum un peu plus grand, à bord postérieur un peu arrondi, présentant une impression triangulaire médiane, sa surface couverte de très petits tubercules espacés. Episternes très développés, surtout au métathorax, présentant la forme d'une grande plaque à peu près triangulaire, à bord interne convexe, divisée par un sillon oblique; épimères peu développés, formant un petit bourrelet en arrière du bord externe des épisternes.

Il existe deux stigmates à péritrème ovale, de chaque côté, entre le pro- et le mésothorax et entre ce dernier et le métathorax.

Abdomen.—Abdomen déprimé, à bords lamellaires, testacé très clair en dessus, plus foncé en dessous. Tergites imbriqués, à pubescense presque nulle, présentant près de la base une ligne saillante qui marque l'insertion de la membrane articulaire, et marqués du 2^e au 7^e, d'une impression latérale arrondie. Forme des tergites analogue dans les deux sexes jusqu'au 7^e: le 1er environ quatre fois aussi large que long, à bord postérieur convexe, les suivants à bord postérieur un peu sinué, presque droit au milieu, s'élargissant faiblement du 2^e au 7^e puis devenant plus étroits jusqu'à l'apex de l'abdomen; les angles postérieurs sont saillants, surtout aux derniers tergites et chez la femelle. Chez le mâle, le 8^e tergite est court, à angles peu saillants, bord postérieur convexe, un peu sinué latéralement, le 9^e est très court, entièrement caché par la 8^e, à angles à peine visibles sur le côté; le 10^e forme une plaque suranale assez grande, trapézoidale, à bords latéraux un peu sinués, bord postérieur légèrement concave, angles postérieurs très arrondis; sa surface est un peu déprimée au milieu et ondulée sur les côtés, ses bords latéraux sont garnis de longs poils roux; 11^e tergite membraneux, caché sous la plaque suranale. Chez la femelle, les 8^e et 9^e tergites sont très courts, à bord postérieur convexe et angles un peu saillants; le 10^e forme une grande plaque suranale triangulaire à bords convexes, très profondément et anguleusement échancrée à son apex; elle est faiblement carénée au milieu, un peu déprimée sur les côtés et couverte d'une pubescence rousse assez longue mais espacée.

Sternites imbriqués comme les tergites, au nombre de 7 visibles chez la femelle, 8 chez le mâle; 1er sternite absent dans les deux sexes, suivants réguliers, à bord postérieur presque droit jusqu'au 6e, qui est un peu dilaté au milieu du bord postérieur. Chez le mâle, le 7e est semblable aux précédents, le 8e est court, à bord postérieur un peu concave et angles arrondis; le 9e forme une plaque sous-génitale assez grande, très largement tronquée à son extrémité, ses bords latéraux un peu convexes, son bord postérieur légèrement concave; sa surface est un peu déprimée vers l'apex et sur les côtés, formant ainsi deux petites carènes arrondies, dans le prolongement des angles postérieurs; ceux-ci portent deux styles grêles, un peu incurvés en dedans, de la longueur de le plaque sous-génitale. La plaque est glabre et présente une ponctuation espacée dans la moitié apicale; les styles portent une pubescence rare. Chez la femelle, le 7e sternite forme la grande plaque sous-génitale, de forme analogue à celle des autres espèces du genre, divisée en deux parties par une suture très nette mais interrompue latéralement; la partie proximale est fortement bombée, à angles saillants et un peu relevés, sa surface est couverte d'une pubescence rare et est éparsément ponctuée au milieu; la partie distale est fortement comprimée en carène et divisée presque jusqu'à sa base, son bord supérieur est droit, bord inférieur convexe, angle apical un peu arrondi; toute la surface porte une pubescence courte mais assez dense.

Valves anales triangulaires, fortement chitinisées, noirâtres, à bord apical fortement aminci, lamellaire, un peu sinué.

Cerques assez longs, un peu déprimés, à bord externe formant un bourrelet un peu épaissi, comprenant 16 articles s'allongeant de la base à l'apex qui est assez aigu; face supérieure déprimée, presque glabre, face inférieure un peu convexe, velue.

Organe copulateur du mâle.—Les pièces génitales, de formes compliquées, dépassent un peu l'extrémité abdominale et peuvent être divisées en deux groupes superposés. Le groupe supérieur comprend trois pièces fortement chitinisées, noirâtres, réunies par leur base, et dont l'une se trouve en dessous des deux autres; les deux pièces supérieures sont complètement soudées à la base, celle de droite est arrondie, à apex couvert de petits tubercules pointus, celle de gauche est allongée, recourbée et pointue à l'extrémité, en bec d'oiseau; la pièce inférieure est large, terminée par deux cornes un peu courbes. Le groupe inférieur comprend des pièces en partie membraneuses, à limites assez peu précises, où l'on peut séparer: á droite, une pièce présentant une large plaque chitineuse à peu près rectangulaire, dont le bord se replie un peu à la face supérieure; à gauche, une très grande pièce repliée en charniére au bord externe, dont la partie inférieure est très allongée, étroite et terminée par un petit crochet bifide; au milieu, une pièce plus petite, faiblement chitinisée, portant à l'apex un prolongement grêle et recourbé. Sur les préparations à la potasse, on voit que le groupe supérieur prend appui sur une pièce interne, assez volumineuse, qui se replie en dessous et vient au contact des pièces du groupe inférieur vers le milieu.

Oviscapte.—L'oviscapte, long de 3 millimètres, est très profondément caché sous la base du 7^{e} sternite ; il présente 6 valves bien développées et assez fortement sclérifiées. Les valves inférieures sont élargies à la base, arrondies à l'apex, pubescentes à la face interne ; valves supérieures aussi longues que les inférieures, plus membraneuses, un peu repliées en gouttière autour des valves internes ; ces dernières sont un peu plus courtes, grêles, subaiguës à l'apex. La base de l'oviscapte est un peu recouverte par le 8^{e} sternite, formant une languette arrondie, véritable plaque sous-génitale morphologique.

Pattes.—Pattes antérieures : hanches allongées, assez larges à la base, rétrécies vers l'extrémité ; face antéro-interne assez fortement convexe, couverte d'une ponctuation pilifère assez espacée, face externe creusée en gouttière pour recevoir le fémur, glabre ; bord antéro-interne un peu comprimé en lame, surtout dans la partie apicale, lobes apicaux petits, le supérieur très arrondi. Trochanters courts, presque glabres. Fémurs un peu plus longs que les hanches, un peu comprimés, à surface faiblement ponctuée et pubescente ; bord supérieur arrondi ; bords inférieurs saillants, face inférieure sillonnée, le bord externe armé de 4 épines presque égales et équidistantes, le bord interne d'une rangée de 15 épines assez fortes, serrées, subégales ; apex présentant à la face interne deux longues épines noirâtres, la supérieure un peu plus longue que l'inférieure. Tibias plus courts que les fémurs, assez épais, cylindriques, armés de 14 épines fortes, noirâtres, dont 4 apicales, 3 supérieures (2 internes, 1 externe) et 7 inférieures (4 internes, 3 externes) ; la surface du tibia est ponctuée de points pilifères et son bord inférieur est garni d'une assez longue pubescence rousse. Tarses un peu plus longs que les tibias, assez épais, faiblement comprimés ; métatarses un peu plus longs que les trois articles suivants réunis, un peu dilatés à l'apex, très finement serrulés en dessous, articles II à IV courts et épais, V presque égal au métatarse, grêle, un peu incurvé ; griffes fortes, épaisses, avec une pelotte tronquée au sommet, jaunâtre, entre leurs bases ; surface des cinq articles ponctuée et pubescente.

Pattes intermédiaires : hanches très grandes, comprimées, à face supéro-externe très large, un peu concave, glabre : face inférieure un peu bombée, ponctuée et pubescente ; bord supéro-externe peu marqué, terminé par un lobe apical arrondi, assez étroit et bien détaché, bord supéro-interne assez fortement comprimé en lamelle, à lobe apical presque nul. Trochanters et fémurs de forme analogue aux antérieurs ; fémurs un peu plus longs, présentant, à la face interne, un sillon ondulé longitudinal près du bord supérieure, la partie limitée par ce sillon étant assez fortement ponctuée ; face externe plane, lisse ; apex armé de deux longues épines externes, un peu courbes ; bord inférieur externe armé de 7 épines noirâtres, médiocres, bord interne de 6 épines un peu plus longues, dont la 6^{e} apicale, et la 1re rapprochée de la base et plus courte que les autres. Tibias presque cylindriques, assez épais, armés de 4 épines apicales, 8 supérieures (3 internes, 3 médianes, 2 externes) et 9 inférieures (4 internes, 5 externes). Toutes ces épines sont un peu incurvées, arrondies en dessus et en dessous, finement striées longitudinalement. Tarses un peu plus allongés que les tarses antérieurs, à métatarse peu dilaté à l'apex, presque aussi long que les autres articles réunis.

Pattes postérieures de forme très analogue aux pattes intermédiaires mais plus allongées. Hanches très larges, à lobe apical interne étroit, allongé. Fémurs armés de 3 épines apicales, 1 interne et 2 externes; leur bord inférieur externe portant 7 épines et le bord interne 6. Tibias allongés, armés de 30 épines environ, dont 4 apicales, 14 supérieures (5 externes, 5 médianes, 4 internes) et 13 à 15 inférieures (6 à 7 externes, 7 à 8 internes). Tarses très allongés, grêles; métatarses presque aussi longs que les autres articles réunis, non dilatés à l'apex, 5ᵉ article très grêle.

ELYTRES ET AILES.—Organes du vol dépassant, dans les deux sexes, l'extrémité de l'abdomen. Elytres larges, brun roussâtre éclairci vers l'apex, à bord antérieur très faiblement convexe, bord interne presque droit, apex arrondi. Veine discoïdale un peu sinuée, à 8-10 rameaux presque tous divisés vers le milieu; veine médiane bifurquée peu après le milieu de l'élytre, portant 8 à 10 rameaux subdivisés, parallèles entre eux et un peu sinués. L'ensemble de ces nervures est assez confus, les espaces internervaires coupés de fausses nervures et occupés par de très nombreuses nervules transversales formant des aréoles très petites, punctiformes vers la base; dans le champ antérieur, une assez longue portion basale est dépourvue de nervures et garnie d'une réticulation fine et irrégulière. Champ anal allongé, à bord interne droit, présentant une quinzaine de nervures peu nettes, à intervalles ponctués-aréolés.

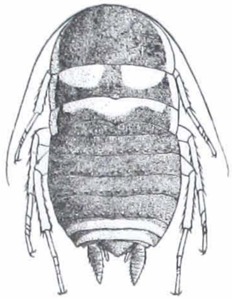

FIG. IV.—*Periplaneta cavernicola*, n. sp.
Jeune individu, × 7.

Ailes larges, à échancrure anale peu marquée, champ antérieur très large, brunâtre, champ postérieur jaunâtre, presque transparent. Veine médiastine peu marquée, à 3 ou 4 rameaux; veine médiane portant 6 rameaux très subdivisés; ulnaire postérieure à 7 rameaux bifurqués pour la plupart; champ postérieur occupé par une douzaine de nervures droites dont la 1ʳᵉ quatre fois divisée. Nervules assez nombreuses, plus serrées dans le champ antérieur.

DIMENSIONS.—Les dimensions, peu variables et semblables pour les deux sexes, sont les suivantes :—

Long. du corps ..	34-36 mm.	Tibia ant. ..	5 mm.
,, ,, pronot. ..	9 mm.	Fémur interm. ..	9 mm.
Elytres	28 mm.	Tibia interm. ..	8·5 mm.
Ailes	24 mm.	Fémur post. ..	10 mm.
Fémur ant. ..	7 mm.	Tibia post. ..	13·5 mm.

Cette espèce ressemble beaucoup à *P. americana* L. mais s'en distingue aisément par sa coloration plus uniforme et les organes du vol beaucoup moins allongés. Chez le ♂, les pièces génitales sont très différentes, ainsi que la plaque suranale, et les styles sont plus courts et plus épais. Les jeunes individus sont vivement pigmentés ainsi que le montre la figure iv.

Gen. **Spelaeoblatta,** Bolivar.

Spelaeoblatta gestroi, Bolivar.

Bolivar 1897, *Ann. Mus. Stor. nat. Genova*, xxxviii, p. 32.

Shelford 1910, *Genera Insectorum, Blattidae*, subf. *Blattinae*, p. 23.

Caverne de Jado, Karen country, 1,200-1,300 m. (*L. Fea*, Janr. 1888).

Cette intéressante espèce est certainement un des Orthoptères présentant les caractères les plus marqués d'adaptation à la vie obscuricole. Elle a été décrite très complètement et figurée par Mr. le P. I. Bolivar dans l'ouvrage cité ci-dessus. Elle n'est connue que par l'exemplaire typique conservé au Musée de Gênes.

Subfam. *CORYDIINAE.*

Gen. **Miroblatta,** Shelford.

Ce genre avait été placé par Shelford (Gen. Insectorum, 1910, p. 21), dans la sous-famille des *Blattinae*, mais le regretté et savant Orthoptèriste anglais n'en connaissait que le mâle ; je donne ci-dessous la description d'une femelle paraissant, sans aucun doute, devoir être rapportée à ce même genre et qui présente des caractères rappelant les *Homoeogamia* Burm., d'Amérique ; la forme de la plaque sous-génitale ne permet d'ailleurs pas de la ranger parmi les *Blattinae.*

Miroblatta silphoides, n. sp.

Pl. XII, figs. 10-14.

Batu caves, near Kuala Lumpur (*N. Annandale*, 2-1-16); burrowing in bat's guano among stones, at entrance to caves. 1 ♀.

Assez grande espèce, noirâtre, à faciès de Coléoptère ; pattes, antennes et pièces buccales brun foncé, un peu roussâtre ; clypéus présentant une bande blanchâtre très nette. Toute la surface du corps couverte d'une assez fine ponctuation et d'une pubescence rousse, très courte et serrée ; sur le pronotum, cette pubescence est portée par de petits tubercules arrondis, luisants.

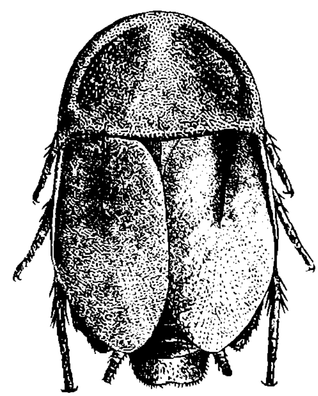

FIG. V.—*Miroblatta silphoides*, n. sp. Femelle, × 2·5.

TÊTE.—Tête entièrement cachée sous le bord antérieur du pronotum, assez étroite, brun noirâtre avec les pièces buccales rousses et une bande blanche divisant le clypéus en deux parties presque égales ; occiput assez fortement bombé, brun foncé, luisant, vertex convexe, étroit, front peu bombé, fortement ridé et ponctué, garni d'une longue pubescence rousse, dressée, écusson facial un peu aplati, fortement ridé-ponctué ; entre le front et l'écusson, se trouve une très profonde impression ayant à peu près la forme d'une paire de lunettes. Clypéus presque rectangulaire, à bord supérieur arqué, bord inférieur droit, partie supérieure brun roux, un peu plus large que la partie inférieure, blanche; surface assez faiblement ponctuée et pubescente. Labre large, roux, avec une étroite bande blanche basale à surface ponctuée et fine pubescence rousse.

Yeux noir verdâtre, très étroits, allongés un peu élargis aux deux extrémités qui sont arrondies; les facettes, extrêmement fines, sont absolument imperceptibles à un grossissement moyen (40 diamètres). Taches ocellaires très nettes, jaunâtres, un peu bombées, situées un peu au dessus des deux extrémités de la profonde impression frontale.

Antennes courtes, de 45 articles environ, très foncées à la base, devenant près de l'apex blanchâtres; 1^er^ article assez gros, fortement renflé à l'apex, à pubescence fine, assez rare, et présentant près de la base une petite surface bombée, très finement pubescente; 2^e^ article très court, cylindrique, 3^e^ allongé, trois fois plus long que le 2^e^, 4^e^ et suivants très courts, un peu dilatés au sommet, presque glabres jusqu'au 12^e^ environ, devenant ensuite finement pubescents et un peu plus allongés surtout près de l'apex.

Pièces buccales courtes et fortes; mandibules noirâtres, à bord externe fortement convexe, rebordé vers la base, bord interne armé de fortes dents triangulaires, au nombre de 3 à la mandibule droite, 4 à la gauche.

Langue courte et assez large, épaisse, arrondie á l'apex.

Maxilles courtes, à stipes larges, un peu concaves au bord externe; lacinias courts, à bord interne très fortement convexe, armé à l'apex de deux dents courtes et fortes; galeas larges et courts. Palpes courts, à pubescence rare et assez forte, les deux premiers articles blanc jaunâtre, les trois suivants brun foncé; articles I et II très courts, subglobuleux, III assez allongé, un peu déprimé, à bord externe subanguleux au milieu, IV un peu plus court que III, assez fortement dilaté au sommet, V un peu plus long que III, triangulaire à bord interne court, bord apical tronqué droit, apex subaigu.

Labium court, à pièce basilaire et mentum soudés en une grande plaque à bord antérieur sinué, bords latéraux assez fortement convexes dans la partie antérieure; la soudure des deux pièces n'est indiquée que par une rangée de fortes soies et une différence de coloration, le basilaire proprement dit étant brun testacé, le mentum blanchâtre; palpigère court, rectangulaire à bords un peu sinués; lobes très courts, les externes larges, épais, un peu aplatis vers l'apex, les internes en forme de languette presque aussi large à l'apex qu'à la base; pubescence dressée, rousse, rare sur le basilaire, presque nulle sur le palpigère, éparse sur les lobes externes. Palpes assez allongés, brun testacé avec l'apex de chaque article blanchâtre, à pubescence peu abondante, courte et dressée; articles I et II égaux, épais, un peu dilatés à l'apex, III une fois et demie aussi long que II, cylindrique, arrondi à l'apex.

Thorax.—Pronotum très grand, large, à surface très bombée, avec deux profondes impressions longeant le bord antérieur sur presque toute sa longueur; bord antérieur très convexe, bord postérieur presque droit, angles postérieurs subaigus; toute la surface est couverte de petits tubercules arrondis, luisants, plus volumineux et plus épars au fond des impressions latérales; pubescence rousse, couchée et assez rare sur le disque, dressée, un peu plus longue et plus abondante le long du bord antérieur.

Mésonotum assez court, divisé en trois parties transversales; l'antérieure forme un écusson triangulaire visible entre la base des élytres, à surface bombée au milieu et couverte de tubercules semblables à ceux du pronotum mais plus petits, et d'une pubescence rousse; partie moyenne lisse, plus claire que l'écusson, séparée de la partie postérieure par une fine saillie ondulée; partie postérieure courte, à bord postérieur convexe, finement chagrinée et carénée au milieu.

Métanotum de même longueur que le mésonotum, également divisé en trois parties, par des saillies transversales; parties antérieure et médiane lisses, un peu bombées au milieu; partie postérieure finement carénée au milieu et ridée transversalement; bord postérieur un peu sinué.

Dessous du thorax un peu bombé, à pièces sclérifiées testacées, à pubescence rousse; le bord libre du pronotum s'étend très largement, de chaque côté, au-delà des hanches antérieures; sa surface inférieure est très grossièrement ponctuée et pubescente. Prosternum étroit, rectangulaire; en avant de lui, se trouvent les volumineuses pièces jugulaires, arrondies, presque noirâtres.

Méso- et métasternum larges, à bord postérieur convexe, un peu relevé, échancré au milieu, au métasternum; latéralement, tous deux s'étendent jusqu'aux épisternes correspondants, les enveloppant un peu en avant.

Episternes et épimères prothoraciques réduits à de petites pièces transversales en avant des hanches antérieures; au méso- et au métathorax, les épisternes sont assez développés, convexes, élargis à l'extrémité, les épimères sont très petits, presque cachés sous les épisternes, et de même forme qu'eux.

Stigmates prothoraciques grands, très allongés, méso- et métathoraciques beaucoup plus petits, presque ronds.

Abdomen.—Abdomen très large, brun, assez nettement caréné au milieu en dessus. Tergites imbriqués, très courts, s'élargissant du 1^er^ au 4^e^, se rétrécissant ensuite jusqu'à l'extrémité; leur surface est glabre, très finement ridée transversalement, sauf sur les bords latéraux qui sont un peu aplatis, pubescents et finement chagrinés et tuberculés; les 7^e^, 8^e^ et 9^e^ tergites portent aussi quelques rangées de poils raides le long de leur bord postérieur; ce bord est presque droit du 1^er^ au 4^e^ tergite, concave, un peu sinué sur les côtés, jusqu'au 8^e^, faiblement convexe au 9^e^; plaque suranale assez grande, arrondie, très légèrement échancrée à l'apex, à surface couverte de tubercules peu apparents et d'une pubescence rousse, dressée. Sternites brunâtres, finement ridés-chagrinés, avec une pubescence rousse, très fine, couchée, présentant, de chaque côté, une petite impression lisse; 6 sternites visibles, le 1^er^ étant absent, à bord postérieur droit ou légèrement concave; 7^e^ sternite formant la plaque sous-génitale assez grande, à bord postérieur sinué sur les côtés, large à la base et brusquement rétrécie; sa surface étant très fortement convexe, surtout dans la partie rétrécie, apex arrondi.

Stigmates situés entre les tergites et les sternites, complètement cachés sous l'angle postérieur des sternites.

Valves anales courtes, triangulaires, entièrement cachées sous la plaque suranale.

Cerques courts, de 8 à 9 articles (leur extrémité est brisée) dont le 1er est long, cylindrique, les suivants courts, dilatés au milieu ; pubescence raide, rousse avec quelques fortes soies apicales à chaque article.

OVISCAPTE.—L'oviscapte, long de 2 millimètres et complètement caché sous la plaque sous-génitale, se trouve engaîné entre les replis membraneux de la face interne de cette plaque. Ses valves sont membraneuses, presque égales comme longueur ; les inférieures sont un peu tordues sur elles-mêmes et présentent au bord externe deux tubercules blanchâtres entourés de brun, leur face interne porte quelques longs poils ; valves supérieures pliées en forme de gaîne antour des valves internes ; celles-ci sont étroites, presque aiguës à l'apex. La base des valves inférieures est unie par une grande plaque arrondie, appartenant au 8e sternite.

PATTES.—Pattes courtes et fortes, brun noirâtre, à pubescence rousse assez abondante, surtout sur les tibias et sur les tarses. Hanches antérieures allongées, très larges, à face inférieure et interne bombées, pubescentes ; face supérieure plane, presque glabre ; bord supéro-interne assez saillant, dilaté vers l'apex en un lobe arrondi. Trochanters étroits, allongés, à pubescence abondante. Fémurs assez épais, à face inférieure plane, armés de 2 épines apicales inférieures, l'interne un peu plus forte que l'externe ; bords inférieurs portant une rangée de soies raides, irrégulières, beaucoup plus serrées sur le bord interne que sur le bord externe. Tibias courts, épais, élargis à l'apex, armés de 9 épines très fortes, situées dans la partie apicale (4 supérieures, 1 interne, 2 externes, 2 inférieures). Tarses très courts, à pubescence courte et raide ; métatarse égalant à peine les trois articles suivants réunis ; 5e article cylindrique, assez grêle ; griffes fines, peu incurvées, à pelotte presque nulle. Les épines du tibia sont très fortes, épaisses à la base, un peu sillonnées en dessous, mais à bords inférieurs lisses ; leur surface est très finement striée longitudinalement.

Pattes intermédiaires : hanches assez courtes à la face inférieure, très larges, leur bord supéro-interne dilaté en lamelle à sa base, bord supéro-externe peu marqué, terminé par un lobe étroit, arrondi ; face supérieure à peine concave, un peu plus large que la face externe. Fémurs épais, un peu comprimés, à face inférieure plane et bords un peu arrondis, portant des soies semblables à celles des fémurs antérieurs, mais moins nombreuses et moins régulières ; apex armé de 2 épines brunes, assez fortes, 1 externe supérieure et 1 interne inférieure. Tibias très épais, armés de 16 épines dont 5 apicales (2 supérieures, 2 inférieures, 1 externe), 8 supérieures (3 externes, 3 médianes, 2 internes) et 3 inférieures (2 externes, 1 interne). Tarses assez semblables aux tarses antérieurs, mais un peu plus longs.

Pattes postérieures assez allongées mais très fortes ; hanches et fémurs ayant à peu près la même forme qu'aux pattes intermédiaires ; fémurs armés seulement d'une épine recourbée à l'apex du bord supérieur externe, les bords inférieurs arrondis, peu marqués, à pubescence peu abondante, sans caractère spécial. Tibias plus longs que les fémurs, armés de 22 épines dont 5 apicales (2 supérieures, 2 inférieures, 1 externe), 12 supérieures (4 externes, 4 internes, 4 médianes) et 5 inférieures (3 externes, 2 internes); les épines médianes du bord supérieur sont droites et plus longues qui les autres qui sont couchées et un peu incurvées. Tarses assez longs, à métatarse un peu plus long que l'ensemble des autres articles.

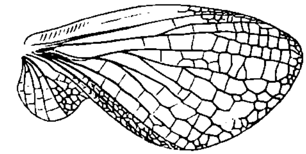

Fig. VI.—*Miroblatta silphoides*, n. sp. Aile droite, × 4.

Elytres et ailes.—Elytres un peu plus courts que l'abdomen, à surface assez bombée, couverte d'une fine ponctuation et d'une courte pubescence rousse, couchée; la côte est très saillante et, en dessous, près de la base, un repli vient couvrir en partie les épisternes et épimères métathoraciques, formant une sorte d'épipleure rudimentaire. Bord antérieur presque droit à la base, convexe ensuite; bord interne presque droit, apex arrondi; à l'élytre droit, la partie du bord interne recouverte par l'autre élytre est lisse, amincie, présentant une faible réticulation irrégulière vers l'apex. La nervation est réduite à une forte nervure située vers le tiers antérieur de l'élytre et se perdant rapidement, les nervures habituelles sont simplement indiquées par les stries formées par la ponctuation et sont surtout visibles vers l'apex de l'élytre.

Ailes peu développées, presque réduites à leur partie antérieure; celle-ci est assez grande, à bords convexes, apex arrondi, de couleur jaunâtre, rembrunie le long des bords antérieur et interne; les nervures sont très marquées, épaisses à la base, mais arrivant à se perdre vers l'apex dans une réticulation large et irrégulière. Veine médiastine simple; humérale trifurquée; veine discoïdale sinuée à la base, portant 3 rameaux dont l'antérieur trifurqué et le médian bifurqué. Champ postérieur très petit, atrophié, occupé par 4 nervures dont la 1re bifurquée.

Dimensions.—Les principales dimensions de l'individu décrit sont les suivantes:

Long du corps	..	25·5 mm.	Fémur ant.	..	5 mm.
,, ,, pronot.	..	9·5 mm.	Tibia ant.	..	3·5 mm.
Larg. ,, ,,	..	14 mm.	Fémur interm.	..	6·5 mm.
Antennes	..	11 mm.	Tibia interm.	..	5 mm.
Elytres	..	16·5 mm.	Fémur post.	..	7·3 mm.
Ailes	..	11 mm.	Tibia post.	..	8·5 mm.

Habitat.—J'ai trouvé un second exemplaire femelle de cette espèce dans la collection Finot (Muséum Paris), provenant de Bornéo.

Bien que trop différente de *Miroblatta petrophila* pour pouvoir en être considéreé comme la femelle, cette espèce me parait devoir être rapportée au même genre. Ses élytres fortement convexes et la forme de la plaque sous-génitale rappellent les *Homoeogamia* Burm., d'Amérique. Sa place me semble donc être plutôt parmi les *Corydiinae* que parmi les *Blattinae* comme le pensait Shelford.

Subfam. *PANCHLORINAE*.

Gen. **Leucophaea,** Brunner.

Leucophaea striata, Kirby.

Pls. XII–XIII, figs. 15–20.

Leucophaea striata Kirby, 1903, *Ann. Mag. Nat. Hist.* (7), XII, p. 378.

Batu caves, near Kuala Lumpur; burrowing in bat's guano at entrance to caves (*N. Annandale*, 2-i-16); nombreux individus.—Batu caves, crawling under sodden log on ground (*N. Annandale*, 2-i-16); on bat's guano on floor (*N. Annandale*, 2-i-16); très nombreux individus de tous les âges.

Goak Glap, Bukit Tapang, Biserat, on the walls of the inner cavern of caves (*N. Annandale*, 4-ii-16); 1 ♂, 1 ♀ et quelque jeunes individus.

Espèce de taille moyenne, à coloration brun roux assez foncé et uniforme, le bord interne des élytres presque transparent, la face un peu plus foncée; pattes et antennes plus claires. Pubescence rare, courte; ponctuation très marquée.

TÊTE.—Tête assez petite, faiblement dégagée en avant du pronotum; occiput très court, à ponctuation fine et espacée; sommet de la tête peu convexe, presque caréné transversalement. Face—triangulaire, rembrunie au milieu; front large, plat, à ponctuation assez forte, espacée; écusson facial sans limites précises, un peu bombé, à ponctuation plus rare que sur le front; joues limitées par un sillon assez profond; clypéus trapézoïdal, à limite supérieure indécise, environ trois fois aussi large que haut, bord inférieur un peu caréné transversalement et présentant un petit sillon médian; la tache brune, qui couvre l'écusson facial et une partie du front, s'arrête par une ligne nette au milieu du clypéus, dont la partie inférieure est très claire; labre très large, arrondi. Pubescence presque nulle sur toute la tête, sauf sur les bords du labre qui sont frangés de poils courts.

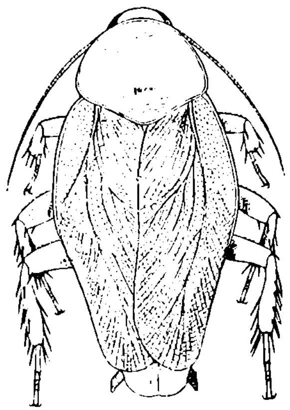

FIG. VII.—*Leucophaea striata*, Kirby. Femelle, × 3.

Yeux allongés, noirâtres, très étroits, leur moitié supérieure s'élargissant un peu au-dessus de la fossette antennaire, leur moitié inférieure à bords presque parallèles; bord externe presque droit, en contact avec le bord antérieur du pronotum; bord interne profondément échancré autour de la fossette antennaire; bord supérieur faiblement convexe, formant deux angles arrondis, facettes très petites. Ocelles blanchâtres, situés sous le bord supérieur de l'oeil, dans l'angle interne de la fossette antennaire; la distance qui les sépare de l'oeil est à peine égale à leur propre diamètre.

Antennes assez courtes, rousses, de 55 articles environ; 1er article assez grand, un peu dilaté au sommet, 2e court, cylindrique, 3e un peu plus long que le 2e, 4e au 10e très courts, un peu évasés à l'apex; du 11e au 22e environ, les articles sont encore plus courts, en forme de rondelles un peu dilatées au milieu ; à partir du 23[e], ils s'allongent un peu et deviennent moniliformes. La pubescence est rare sur les dix premiers articles qui sont luisants, presque glabres ; elle devient assez abondante sur les suivants et est rousse et dressée.

Pièces buccales courtes, testacées ; mandibules fortes, larges, à bord externe fortement convexe ; leur bord interne armé de dents noirâtres, triangulaires, assez aiguës tranchantes, au nombre de 3 à la mandibule droite et 4 à la mandibule gauche ; à chaque mandibule, la dent inférieure étant suivie d'une sorte de talon à deux crêtes.

Hypopharynx court et très étroit, formant une languette à bords parallèles, arrondie à l'apex, à face supérieure carénée.

Maxilles à pièces basilaires longues et étroites, à angle externe peu saillant, arrondi ; lacinias courts, très larges, à bord externe presque droit, glabre, bord interne très fortement convexe, garni de poils raides, apex armé de deux petites dents aiguës, très rapprochées ; galeas dépassant un peu les lacinias, assez larges, formant à l'apex une sorte de capuchon garni en dedans d'une fine pubescence feutrée. Palpes assez courts, à article I très court, globuleux, II un peu plus long, dilaté á l'apex, III allongé, un peu comprimé, à bord supérieur convexe, IV un peu plus court que III, fortement dilaté à l'apex, V un peu plus long que III, large, à bord supérieur droit, bord inférieur un peu convexe, apex largement tronqué ; pubescence courte, dressée et peu abondante.

Labium à pièce basilaire très large, son bord supérieur assez fortement concave, ses bords latéraux lamellaires, à convexité très accentuée ; mentum très large, à bord supérieur sinué ; palpigère presque carré dans son ensemble, profondément sillonné au milieu ; lobes courts, les externes larges, à bord externe fortement convexe, apex arrondi, les internes petits, triangulaires. Palpes assez longs, à articles I et II de longueur égale, un peu déprimés, le premier faiblement dilaté à l'apex, article III égalant presque les deux autres réunis, cylindrique, non dilaté à l'apex qui est arrondi. Pubescence très rare sur les pièces fixes, plus abondante sur les lobes externes et sur les palpes.

THORAX.—Pronotum large, un peu convexe, très fortement arrondi antérieurement, son bord postérieur assez fortement convexe au milieu, sinué sur les côtés, formant avec le bord antérieur un angle très arrondi ; surface brun roussâtre uniforme, assez régulièrement et fortement ponctuée, avec quelques fines rides transverses vers le milieu du bord antérieur ; pubescence nulle ; bords finement rebordés tout autour.

Mésonotum en partie caché sous le pronotum, son bord postérieur faiblement convexe, prolongé par une membrane transparente, tronquée carrément à l'apex et sur les côtés ; cette membrane libre, recouvre en partie le métanotum ; l'insertion des élytres est reportée très haut, sous l'angle latéral du pronotum ; sur le disque, près de la ligne médiane, se trouvent deux impressions assez profondes, allongées longitudinalement.

Métanotum à bord postérieur presque droit, présentant, comme le mésonotum, une membrane libre dont le bord postérieur est légèrement biconcave, disque présentant, deux impressions moins profondes et moins allongées que celles du mésonotum.

Dessous du thorax testacé, à pièces sclérifiées très étroites par suite du rapprochement des hanches qui sont, surtout aux deux paires postérieures, presque contiguës sur la ligne médiane.

Prosternum étroit, allongé, un peu élargi au bord antérieur qui est droit et porte un petit tubercule médian arrondi, garni de poils roux ; moitié postérieure présentant un profond sillon longitudinal. Episternes et épimères très peu développés, formant deux pièces triangulaires, étroites, en avant des hanches antérieures ; dans la membrane d'union, entre l'épimère et la hanche, se trouve un petit tubercule semblable au tubercule médian du prosternum. Un stigmate s'ouvre, sur un petit mamelon membraneux, en arrière de la hanche et en avant de l'épisterne mésothoracique ; il peut être considéré comme appartenant au prothorax.

Mésosternum petit, carré dans son ensemble, présentant en avant une petite carène anguleuse. Métasternum très réduit, présentant un petit sillon longitudinal et deux invaginations profondes et presque contiguës dans sa partie postérieure. Episternes et épimères méso- et métathoraciques beaucoup plus développés qu'au prothorax, formant, en avant des hanches, une grande plaque de forme quadrangulaire assez régulière, divisée par une suture oblique ; les épisternes présentent au bord supéro-externe un épaississement arrondi séparé par un profond sillon. Il existe un seul stigmate, entre le méso- et le métathorax, occupant la même situation que le stigmate prothoracique. Pubescence rare, dressée.

ABDOMEN.—Dessus de l'abdomen déprimé, surtout chez le mâle, dont le bord latéral des tergites est lamellaire ; coloration testacé roux, plus clair chez le mâle ; pubescence presque nulle. Forme des tergites semblable dans les deux sexes, sauf vers l'apex où l'abdomen est plus étroit chez le mâle ; 1er tergite assez long, présentant une suture transversale saillante vers le tiers antérieur ; toute la partie postérieure à cette suture est libre, recouvrant en partie le tergite suivant, la suture est un peu concave, le bord postérieur convexe ; tergites suivants jusqu'au 7^{e} présentant une forme analogue, mais à bord postérieur droit pour les trois premiers, puis légèrement concave ; la largeur des tergites croit puisqu'au 4^{e}, diminue ensuite jusqu'au 9^{e}, la longueur est à peu près égale du 2^{e} au 7^{e} ; 8^{e} tergite court, à bord postérieur un peu sinué, convexe au milieu chez la femelle, concave chez le mâle, angles saillants ; 9^{e} tergite très court, convexe chez la femelle, presque droit avec une petite échancrure médiane chez le mâle ; 10^{e} tergite formant la plaque suranale semblable dans les deux sexes, large, très arrondie, déprimée avec, chez la femelle, une petite carène médiane et une très faible échancrure à l'apex, 11^{e} tergite membraneux, arrondi, très petit, caché par la plaque suranale.

Dessous de l'abdomen roux testacé, déprimé vers la base, fortement convexe vers l'apex ; sternites visibles au nombre de 6 chez la femelle, 7 chez le mâle, présentant près du bord externe une petite ligne brune oblique. Comme les tergites, les sternites sont imbriqués, libres sur presque toute leur longueur, la membrane unissant chaque sternite au sternite précédent venant s'insérer près de la base, sur une ligne marquée par une suture saillante. 1er sternite nul dans les deux sexes ; 2^{e} sternite assez grand, à bord postérieur un peu convexe; 3e et 4e courts à bord postérieur légèrement convexe et droit, 5e et 6e un peu plus longs, à bord postérieur concave; chez la femelle, le 7e forme une grande plaque sous-génitale triangulaire, à bords très faiblement sinués, assez largement arrondie à l'apex; chez le mâle, le 7e sternite est plus long que les précédents, à bord postérieur étroit, concave, angles arrondis, le 8e forme la plaque sous-génitale assez petite, presque carrée, à bord postérieur droit et angles fortement arrondis. Valves anales très petites, en grande partie membraneuses accolées sous la plaque suranale. Les stigmates s'ouvrent dans l'angle inférieur de chaque sternite (jusqu'à la plaque sous-génitale exclusivement), tout à fait au bord externe; ils sont recouverts par une petite plaque transparente arrondie, en forme d'opercule.

Cerques courts, insérés dans l'angle basal de la plaque suranale, arrondis à la base, déprimés vers l'apex, leur bord externe assez fortement convexe, apex arrondi; 10 articles chez le mâle, 11 chez la femelle, le 1er assez long, les suivants très courts, subégaux, le dernier plus étroit et allongé surtout chez le mâle; pubescence nulle en dessus, courte et serrée en dessous, formant une ligne transversale sur chaque article. Styles nuls.

Organe copulateur du mâle.—L'ensemble des pièces génitales fait assez fortement saillie au-delà de la plaque sous-génitale et comprend: (i) une grande pièce inférieure, divisée dans sa moitié apicale en deux parties dont la gauche chevauche par dessus la droite; toutes deux sont larges, la première arrondie à l'apex, la seconde présentant un petit crochet aigu; (ii) reposant sur cette pièce basale, se trouvent les pièces entourant l'orifice génital, qui sont au nombre de trois: à droite, une grande pièce membranense, conique, terminée par une fine baguette chitineuse recourbée en crochet; au milieu, une petite pièce chitineuse arrondie, présentant deux saillie aiguës au bord interne; à gauche, une pièce quadrangulaire à bords chitineux, le bord supérieur un peu arrondi, le bord interne épaissi, noirâtre, dédoublé en forme de V. Il faut enfin signaler que la valve anale droite est assez fortement épaissie et chitinisée à son bord postérieur qui forme un bourrelet saillant, arrondi.

Oviscapte.—Oviscapte rudimentaire, entièrement caché par la plaque sous-génitale. Valves inférieures très légèrement élargies au milieu, un peu rétrécies avant l'apex qui est déprimé et très faiblement incisé; leur base est fixée sur une pièce transversale, à bord supérieur arqué, représentant le 8e sternite. Valves supérieures et internes plus courtes que les valves inférieures, arrondies à l'apex, les supérieures plus larges que les internes. Les valves sont entièrement membraneuses, les inférieures portant une légère pubescence à la face interne.

Pattes.—Pattes testacé jaunâtre uniforme, à pubescence très rare. Pattes antérieures: hanches allongées, un peu comprimées et rétrécies vers l'apex; face externe légèrement concave, face interne convexe; bord supérieur caréné, lamellaire dans la moitié distale, terminé par un lobe apical arrondi. Trochanters à face inférieure allongée, assez fortement convexe. Fémurs comprimés, assez courts, à face inférieure plane; bord supérieur légèrement convexe, arrondi; bords inférieurs un peu saillants, l'externe presque droit, muni de quelques soies; l'interne un peu sinué, portant une sorte de peigne formé de 25 soies environ, courtes, spinuliformes, occupant un peu plus de la moitié apicale du fémur; plus près de la base, ce même bord porte 4 longues soies; lobes apicaux externe et interne armés d'une petite épine mobile, brune. Tibias très courts dilatés en triangle, épais à l'apex, armés de 12 épines fortes, un peu courbées, brunes, dont 6 situées à la face interne (4 au bord supérieur, 2 au bord apical), 2 vers l'apex de la face inférieure, et 4 sur la face externe (2 médianes, 2 apicales). Tarses assez courts, presque glabres; 1er article égal aux trois suivants réunis, ceux-ci très courts; tous quatre un peu dilatés en dessous à l'apex; 5^{e} article assez long, cylindrique; griffes courbes, fortes, avec une pelote arrondie entre leurs bases.

Pattes intermédiaires: hanches contiguës sur la ligne médiane, larges, comprimées, à face inférieure convexe, face supéro-externe un peu déprimée, logeant le fémur, face interne presque plane: le bord supéro-externe est peu marqué, incurvé en avant et se termine par un lobe apical assez petit, mais bien détaché, saillant; le bord supéro-interne est fortement comprimé, lamellaire. Trochanters et fémurs ayant la même forme qu'aux pattes antérieures, les fémurs un peu plus allongés, ne portant pas de peigne au bord inférieur interne et armés à l'apex de deux épines inférieures et d'une supérieure interne; le bord inférieur externe porte en outre une épine près de l'apex. Tibias un peu comprimés, assez épais, mais cependant plus allongés que les tibias antérieurs, armés de 18 fortes épines insérées sur les bords supérieur et inférieur et autour de l'apex, de la façon suivante: 8 sur le bord supérieur dont 3 médianes, 2 externes et 3 internes, 5 sur le bord inférieur, 5 à l'apex dont une sur la face interne; l'épine apicale inféro-externe est la plus longue; toutes ont sensiblement la même forme et sont arrondies en-dessus, sillonnées en-dessous et finement denticulées sur les bords inférieures. Tarses semblables aux tarses antérieurs mais un peu plus allongés.

Pattes postérieures: hanches et fémurs presque semblables aux intermédiaires, les hanches encore plus larges, les fémurs présentant quelquefois deux petites épines au bord inférieur externe au lieu d'une. Tibias beaucoup plus allongés, faiblement élargis à l'apex, armés de 25 longues épines, présentant une disposition analogue à celle rencontrée aux tibias intermédiaires (13 au bord supérieur, 7 au bord inférieur, 5 apicales). Tarses un peu plus longs que les tarses intermédiaires, de forme semblable.

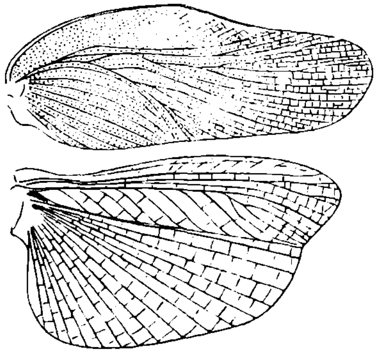

FIG. VIII.—*Leucophaea striata*, Kirby. Nervation de l'élytre et de l'aile droits, × 4.

ELYTRES ET AILES.—Organes du vol bien développés dans les deux sexes, ne dépassant pas l'apex du 7^{e} tergite chez le mâle, atteignant parfois, chez la femelle, l'extrémité de l'abdomen. Elytres de couleur brun roussâtre, assez foncé à la base, presque transparent vers l'apex et le bord interne, surtout à l'élytre droit ; bord externe fortement convexe vers la base, puis légèrerment sinué, bord interne droit, apex largement arrondi ; chez le mâle, l'élytre est un peu plus large que chez la femelle, à bord antérieur à peine sinué. Nervation assez variable, les nervures peu saillantes, se perdant vers l'apex et au bord antérieur au milieu de nombreuses fausses nervures ; les espaces internervaires sont occupés, dans la moitié proximale, par une ponctuation bien marquée, sur un ou deux rangs, dans la moitié distale, par de nombreuses veinules perpendiculaires aux nervures. Veine discoïdale un peu sinuée, portant 8 à 10 rameaux peu distincts des fausses nervures et ne commençant qu'assez loin de la base, laissant un espace garni seulement d'une ponctuation assez régulière ; veine médiane bifurquée vers le tiers apical, portant 4 à 6 rameaux parallèles, presque tous divisés à nouveau une ou deux fois. Champ anal assez large, ovoïde, occupé par 8 à 9 nervures subparallèles dont les intervalles sont remplis par une assez forte ponctuation sur deux rangs.

Ailes un peu plus courtes que les élytres, transparentes, un peu rembrunies vers l'apex et le bord antérieur ; veine médiastine presque droite, portant 6 à 7 rameaux, veine médiane bifurquée vers l'apex, ses deux rameaux à leur tour divisés ; veine ulnaire postérieure un peu convexe, portant 9 à 10 rameaux parallèles, sinués, le dernier une ou deux fois bifurqué ; champ postérieur occupé par une quinzaine de nervures simples. Nervules assez peu nombreuses, simples, perpendiculaires aux nervures.

DIMENSIONS.—Les mâles sont, chez cette espèce, beaucoup plus petits que les femelles ; leurs dimensions respectives, assez peu variables, sont les suivantes :

	♂	♀		♂	♀
Long du corps . .	15-16·5 mm.	20-22 mm.	Fém. ant. . .	2-2·2 mm.	3-3·2 mm.
„ „ pronot.	4-4·5 mm.	5-5·5 mm.	Tibia ant. . .	1-1·1 mm.	1·5-1·7 mm.
Elytres . .	8-9 mm.	13-15 mm.	Tibia interm.	2·1-2·3 mm.	2·6-2·8 mm.
Ailes . .	5·5-6 mm.	10·5-12 mm.	Tibia post. . .	3·5-3·7 mm.	4·5-4·8 mm.

HABITAT.—Cette espèce a été décrite par Kirby sur des individus provenant de Selangor et trouvés en dehors des grottes. D'après la description, trop brève comme celle de *Paradiestrammena annandalei*, les individus lucicoles sembleraient un peu plus colorés et peut-être un peu plus grands que les cavernicoles. Je n'ai malheureusement pas eu la possibilité de les comparer. Les individus de Jalor et ceux de Selangor ne m'ont paru montrer aucune différence ; dans les deux grottes, le nombre des jeunes recueillis était considérable par rapport à celui des adultes. Ils présentent, dans les deux sexes, des styles au 9^e^ sternite.

Fam. PHASGONURIDAE.

Subfam. *RHAPHIDOPHORINAE.*

Gen. **Rhaphidophora**, Serville.

Ce genre comprend un assez grand nombre d'espèces habitant la région indienne et indo-australienne ; la plupart ont des habitudes obscuricoles mais quelques-unes d'entre elles seulement ont été rencontrées dans les cavernes.[1] Ces formes réellement cavernicoles ne diffèrent du reste que par des caractères de très faible importance des formes lucicoles voisines ; celles-ci ont d'ailleurs, je le répète, le faciès et les moeurs d'espèces cavernicoles et, de mêmeque les *Troglophilus* d'Europe, pourraient se rencontrer à la fois dans les grottes et dans les endroits humides à l'air libre. Des trois espèces décrites ici, deux sont franchement cavernicoles, la troisième a été rencontrée dans la jungle.

Rhaphidophora cavernicola, Chopard.

Pl. XIII, figs. 21–28.

Rhaphidophora cavernicola, Chopard 1916, *Bull. Soc. ent. Fr.*, p. 114.
Rhaphidophora gracilis, Griffini 1915, *Atti. Soc. it. Sc. nat.*, p. 96.

Langkawi Id. (in cave), off W. coast of Malay Peninsula (*B. H. Buxton*) ; 2 ♂, 1 ♀.

Grande et forte espèce ; couleur roussâtre presque uniforme, les fémurs postérieurs marqués de nombreuses stries obliques un peu plus foncées que le fond ; pubescence rare et extrêmement fine.

Tête.—Occiput peu bombé, roussâtre veiné de brun, front très court, déclive ; rostre frontal brun, assez allongé, étroit, très légèrement échancré au sommet et sillonné sur toute la longueur de sa face supérieure ; base portant deux grandes taches ocelliformes blanchâtres, très nettes. Face très large dans sa partie supérieure ; écusson facial brunâtre, environ trois fois plus large que long, assez fortement bombé au milieu, assez étroit entre les antennes et portant une tache ocellaire nette ; au dessus de chaque angle du clypéus se trouve une petite impression arrondie ; clypéus trapézoïdal, assez large au bord supérieur, presque moitié plus étroit au bord inférieur ; bord supérieur légèrement sinué, bord inférieur biconcave, bords latéraux très profondément échancrés un peu au-dessus du milieu ; disque faiblement caréné transversalement et présentant deux petites impressions près de la ligne médiane, au dessus de cette carène. Labre assez allongé et assez fortement incisé à l'apex. Pubescence presque nulle sur le crâne et sur la face, sauf aux bords du labre.

Yeux petits, noirs, placés très en avant le long de la fossette antennaire ; bord externe convexe, bord interne droit, surface très fortement saillante en avant, l'oeil étant très comprimé dorso-ventralement ; longueur n'atteignant pas tout à fait le diamètre de la fossette antennaire ; plus grande largeur égale à peine à la moitié de la largeur des joues en arrière de l'oeil. Taches ocellaires très nettes, blanc nacré, probablement fonctionnelles.

Antennes environ six fois plus longues que le corps, rousses, à pubescence assez abondante sauf sur les trois premiers articles ; article I très large, un peu déprimé ; à bord interne fortement renflé et venant presque au contact de l'article correspondant de l'autre antenne, bord externe droit, bord apical sinué ; face supérieure un peu velue, face inférieure glabre ; article II cylindrique, un peu étranglé au-dessus de la base, III un peu plus long que II et moins épais, IV à peine moitié de III, V et suivants cylindriques, très courts.

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[1] [So far as my experience goes, those species of this genus which live in caves are found only under stones or in holes in the floor, while *Paradiestrammena* lives unsheltered on the walls and floor. *N. A.*]

Pièces buccales : mandibules très fortes, pyramidales à arêtes nettes, face externe plane ; apex bidenté, bord interne noir, à double crête dentée.

Hypopharynx large, plus court que le labium, légèrement échancré au sommet.

Maxilles fortes, à pièces basilaires saillantes, faiblement anguleuses au bord externe ; lacinias larges, à bord externe fortement convexe, apex tridenté, la dent médiane un peu plus courte que les deux autres ; bord interne peu convexe, à pubescence serrée mais peu allongée ; galeas assez étroits, un peu plus longs que les lacinias. Palpes très longs, à article I court, dilaté, II une fois et demie aussi long que I, également dilaté à l'apex, III très allongé, grêle, un peu incurvé, IV un peu plus long que III, très grêle à la base, faiblement dilaté vers l'apex, V légèrement plus long que IV, un peu incurvé et s'épaississant jusqu'à l'apex, pubescence peu abondante.

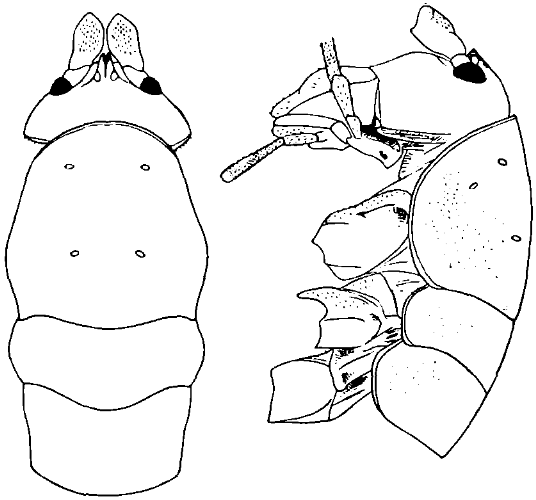

FIG. IX.—*Rhaphidophora cavernicola*, Chop.
Tête et thorax, face dorsale et profil, × 4.

Labium peu allongé, à pièce basilaire large à bords latéraux fortement sinués, à bord apical concave ; mentum assez étroit, presque aussi long que large, à bord supérieur anguleux ; palpigère aussi long que large dans l'ensemble, très profondément divisé au milieu jusqu'à la base ; lobes internes assez étroits, triangulaires ; lobes externes épais, à bord externe peu convexe, apex muni d'une petite fossette à pubescence feutrée ; palpigère assez grand et bien limité, à bord libre arrondi, Palpes très grands, à 1er article assez court et dilaté à l'apex, 2^{e} article allongé, un peu déprimé et renflé au milieu, 3^{e} un peu plus long que les deux premiers réunis, assez fortement dilaté à l'apex. Pubescence dressée, assez rare sur les pièces du labium, plus abondante et très longue sur les lobes externes, peu abondante sur les palpes.

THORAX.—Pronotum assez large, à bord antérieur assez fortement convexe, bord postérieur peu convexe au milieu, légèrement sinué latéralement ; lobes latéraux élevés, bord inférieur convexe, angle postérieur un peu obtus, arrondi, angle antérieur nul, le bord inférieur remontant obliquement depuis le milieu ; les bords antérieur et latéraux sont rebordés et garnis d'une pubescence extrêmement fine et courte. Coloration roussâtre, uniforme, le disque présentant quatre petites impressions arrondies en avant et un peu au-dessous du milieu ; les lobes latéraux portent une impression analogue un peu en dessous de l'impression antérieur du disque ; pubescence très fine, rare sur le disque, plus abondante sur les lobes latéraux.

Mésonotum à bord postérieur plus fortement convexe qu'au pronotum, un peu concave sur les côtés, lobes latéraux élevés, à bord inférieur légèrement convexe en avant, droit et un peu oblique dans les deux tiers postérieurs.

Métanotum de même longueur que le mésonotum, à bord postérieur faiblement et régulièrement convexe ; bord inférieur des lobes latéraux de même forme qu'au mésonotum mais avec l'angle postérieur plus arrondi et la partie convexe en avant un peu plus longue.

Dessous du thorax jaunâtre, à pubescence rare. Prosternum assez étroit en arrière, très élargi en avant, formant une grande plaque triangulaire, sillonnée longitudinalement au milieu ; en avant, de chaque côté du cou, se trouve un gros tubercule à surface sclérifiée, un peu échancré en arrière. Episternes et épimères, ainsi que le stigmate prothoracique, entièrement cachés sous les lobes latéraux du pronotum.

Mésosternum assez large au milieu, rétréci en avant et en arrière où il se termine en une plaque triangulaire un peu saillante ; la partie médiane, très profondément et largement sillonnée, est percée de trois invaginations formant les apodèmes ; partie antérieure épaissie et fortement saillante. Episternes larges, courts, à bord antérieur saillant ; épimères très courts, formant seulement un petit bourrelet en arrière des épisternes ; stigmates petits, en partie cachés sous le mésonotum.

Métasternum très étroit, venant en pointe en arrière et profondément sillonné longitudinalement, la partie postérieure s'élargissant un peu en arrière des hanches postérieures et se divisant en contournant légèrement celles-ci. Epimères et épisternes un peu plus longs qu'au mésothorax, bord inférieur des épisternes légèrement convexe.

Abdomen.—Abdomen allongé, un peu comprimé vers l'apex, roussâtre en dessus, jaunâtre en dessous ; pubescence très fine et peu serrée, très courte sur les tergites, un peu plus longue sur les sternites. Tergites réguliers, chez le mâle, jusqu'au 8^e, à bord postérieur faiblement convexe ; le 9^e déborde légèrement en arrière le 8^e, et est un peu anguleux au milieu ; 10^e tergite large, à bord postérieur un peu concave, bords latéraux obliques ; sa partie médiane est aplatie, formant deux petites arêtes obliques, peu saillantes ; 11^e tergite très allongé, à bords presque parallèles, à apex arrondi ; valves anales larges, triangulaires, aplaties à la face externe et appliquées contre la plaque suranale (11^e tergite). Sternites jaunâtres, à bord postérieur droit, un peu rembruni ; le 1er très étroit, entre les hanches postérieures, les suivants trois à quatre fois plus larges que longs, de longueur à peu près régulière jusqu'au 8^e, celui-ci un peu plus court que les précédents ; 9^e sternite grand, à côtés un peu sinués, tronqué à l'apex et portant, près de la ligne médiane, les styles qui sont séparés par un espace égal à la moitié de leur propre largeur; pubescence courte, dressée, peu abondante et laissant au milieu des sternites, surtout les 7e et 8e, un espace glabre, luisant; latéralement 2 ou 3 longues soies sont insérées sur le bord postérieur de chaque sternite. Styles longs, assez épais et arrondis à la base, légèrement aplatis après le milieu; vus de profil, leur bord supérieur est un peu concave, leur bord inférieur presque droit et remontant obliquement un peu avant l'apex.

Chez la femelle, les tergites ont la même forme que chez le mâle, mais l'extrémité de l'abdomen est un peu plus étroite, le 9e tergite est un peu saillant mais convexe et non anguleux au milieu, la plaque suranale est plus étroite au sommet, presque triangulaire; les sternites présentent un bourrelet blanchâtre, luisant, et sont faiblement carénés longitudinalement du 4e au 7e; ils portent, comme chez le mâle, une pubescence fine et quelques soies latérales insérées sur le bord postérieur; le 1er est très court, les suivants sont à peu près égaux jusqu'au 7e, celui-ci est presque double du précédent, à bord postérieur légèrement concave, bords latéraux convexes; plaque sous-génitale très petite, triangulaire, prolongée en une fine pointe aiguë.

Cerques assez longs, à pubescence fine et longues soies dressées extrêmement ténues.

Organe copulateur du mâle.—L'appareil copulateur, entièrement caché par la plaque sous-génitale, ne comporte aucune pièce sclérifiée; il forme une masse complètement membraneuse présentant, du dessus, une pièce médiane triangulaire divisée à l'apex en trois lobes, et deux petits lobes latéraux; en dessous se trouvent une grande pièce médiane quadrangulaire et deux grands lobes latéraux triangulaires l'ensemble est entièrement mutique sauf à la face inférieure qui présente quelques poils très fins et deux rangées de 5 à 6 spinules près de la ligne médiane du lobe médian de la pièce triangulaire supérieure. Le canal éjaculateur débouche entre ces pièces et est indiqué par deux replis sous la grande pièce quadrangulaire inférieure.

Oviscapte.—Oviscapte court, ne dépassant pas la moitié de la longueur du corps, un peu arqué; valve supérieure très large à la base, à bord supérieur un peu renflé à la base, puis assez fortement concave jusqu'à l'apex qui est arrondi; bord inférieur faiblement convexe, presque droit vers la base. Valve inférieure assez étroite, un peu incurvée; à la base elle se termine en une partie membraneuse venant rejoindre la base de la plaque sous-génitale; son apex est peu aigu, son bord inférieure armé, un peu avant l'apex de cinq dents larges, aplaties; la face externe présente, dans la même région, une carène assez saillante, armée de cinq spinules aiguës. Valve interne étroite, atteignant la partie apicale dentée de la valve inférieure.

Pattes.—Pattes concolores, finement pubescentes. Pattes antérieures: hanches assez courtes à face externe glabre, fortement concave; bord antéro-externe caréné et armé, un peu au-dessus du milieu, d'une petite épine brune; face interne velue, arrondie, mais faisant saillie vers la ligne médiane, l'ensemble de la hanche étant très fortement transversal; les deux hanches antérieures ne sont séparées que par un espace très étroit. Trochanters allongés, cylindriques, insérés vers le milieu de la hanche, laissant vers la face interne un espace libre égal au moins à l'écart entre les deux hanches. Fémurs faiblement renflés à la base et à l'apex, légèrement aplatis en dessous, armés à l'apex d'une épine mobile, courte mais assez forte, insérée au milieu du lobe géniculaire interne. Tibias assez épais, un peu courbes, cylindriques, armés en dessous de 3 épines externes situées à peu près à égale distance entre elles et des deux extrémités du tibia, et d'une épine interne située en face de l'externe moyenne; apex armé de 4 éperons, les deux supérieurs très petits, les deux inférieurs assez forts surtout l'interne; un peu avant l'apex se trouve une très petite épine interne près de la ligne médiane inférieure. Tarses comprimés, assez courts, un peu carénés et glabres en dessous; métatarse atteignant à peine la longueur des autres articles réunis, 2ᵉ et 3ᵉ articles très courts, 4ᵉ un peu plus long que les deux précédents réunis, droit, un peu dilaté à l'apex; griffes fortes, crochues, munies en dessous, près de la base, d'une grande soie.

Pattes intermédiaires: hanches beaucoup moins larges que les hanches antérieures, faisant bien moins saillie vers la ligne médiane, leur face externe aplatie, leur bord antéro-externe mutique, se dilatant en un petit lobe apical aigu. Trochanters courts, cylindriques. Fémurs et tibias semblables comme forme aux fémurs et tibias antérieurs; fémurs armés de deux épines apicales mobiles, égales. Tibias armés en dessus de 2 ou 3 épines sur chaque bord, les internes insérées un peu au-dessus des externes; en dessous de 4 épines disposées par paires vers le milieu et le quart apical, et d'une petite épine externe subapicale; éperons au nombre de 4, les inférieurs un peu plus grands que les supérieurs. Tarses semblables aux antérieurs.

Pattes postérieures: hanches épaisses, aplaties à la face externe, très peu distantes l'une de l'autre; trochanters très courts. Fémurs fortement renflés, à partie filiforme ne dépassant pas le tiers de la longueur totale; leur face externe ornée d'une douzaine de bandes obliques, brunes et pubescentes (la pubescence étant nulle entre ces bandes); apex armé d'une épine géniculaire interne assez forte et aiguë; bords inférieurs saillants, mutiques ou armés d'une très petite épine. Tibias un peu plus longs que les fémurs, arrondis et mutiques en dessous, sillonnés en dessus et armés, sur chaque bord, de 30 à 35 épines brunes, fines, assez régulières, très serrées, commençant très près de la base et allant jusqu'à l'apex; l'épine apicale, de chaque côté, est un peu plus forte que les précédentes. Éperons forts, assez longs; les inférieurs courts, spiniformes, recourbés; les intermédiaires au moins doubles des inférieurs, épais, crochus à l'apex, arrondis et pubescents en dessus, sillonnés et glabres en dessous; les supérieurs semblables aux intermédiaires comme forme, d'une longueur double; les éperons externes sont un peu plus courts que les internes, le supérieur interne atteint l'apex du métatarse. Tarses courts, de même forme que les tarses des autres paires, mais plus comprimés; métatarses armés d'une très forte dent apicale dépassant l'extrémité du 2ᵉ article, et d'une ou deux petites épines vers l'apex du bord supérieur.

Dimensions.—Les principales dimensions des deux individus décrits sont les suivantes:

	♂	♀		♂	♀
Long. du corps..	27 mm.	31·5 mm.	Fémur ant. ..	13 mm.	15 mm.
„ „ pronot.	8·5 mm.	9 mm.	Tibia ant. ..	14 mm.	16 mm.
Antennes ..		env. 180 mm.	Fémur interm. ..	12·5 mm.	14 mm.
Cerques ..	12 mm.	12 mm.	Fémur post. ..	28 mm.	31 mm.
Oviscapte ..		16 mm.	Tibia post. ..	28·5 mm.	31·5 mm.

Cette espèce est voisine de *R. gracilis* Brun., des îles Philippines, mais elle en diffère par sa taille plus faible, les cerques plus courts, les fémurs postérieurs moins grêles, l'éperon supérieur interne des tibias postérieurs atteignant l'apex du métatarse.

Rhaphidophora mulmeinensis, Chopard.

Pl. XIII, figs. 29–32.

Rhaphidophora mulmeinensis, Chopard 1916, *Bull Soc. ent. Fr*, p. 116.

Farm Caves, near Moulmein, in burrow under stones in depth of large dark cave (*F. H. Gravely*, Nov. 1911). 1 ♂.

Espèce de taille probablement moyenne (20 à 25 mm.), de forme assez trapue, à coloration roussâtre presque uniforme, un peu rembrunie sur la tête, le thorax et les pattes; pubescence presque nulle sur le corps, peu abondante sur les appendices.

TÊTE.—Tête un peu moins large que le pronotum en avant; occiput bombé, luisant orné de cinq bandes brunes très étroites; rostre frontal assez grand, étroit, un peu échancré à l'extrémité qui est arrondie, assez profondément sillonnée presque jusqu'à la base; sa face supérieure ponctuée et pubescente, faces latérales portant, à la base, une grande tache ocellaire blanche, nette et venant très près de la ligne médiane. Face assez large, bombée, rembrunie sous les yeux, à pubescence presque nulle; écusson facial environ deux fois plus large que haut, terminé, entre les antennes, en un petit tubercule qui porte une tache ocellaire ovale, placée sous le rostre frontal; clypéus trapézoïdal, à côtés rétrécis au milieu, labre un peu allongé, échancré à l'apex, à bords latéraux convexes, garnis de longs poils.

Yeux petits, comprimés antérieurement, placés le long de la fossette antennaire; leur bord externe fortement convexe, les deux extrémités subanguleuses. Ocelles blanc nacré.

Antennes à 1er article assez grand, jaune pâle avec les bords interne et externe tachetés de brun; bord interne presque droit sur sa plus grande longueur, puis infléchi en dedans vers la base, bord externe faiblement concave dans la moitié apicale, un peu renflé vers la base; 2e article petit, un peu renflé, 3e cylindrique, allongé, 4e et suivants un peu plus courts que le 3e; pubescence fine, assez abondante sur les deux premiers articles, éparse sur les suivants.

Pièces buccales testacées, courtes; mandibules fortes, à bord interne noir, denté, maxilles à pièces basilaires faisant fortement saillie et arrondies au bord externe; lacinias à deux dents apicales dont la seconde plus courte, et une dent antéapicale très fine et très longue; galeas étroits, arrondis à l'apex; palpes très longs, à article I court, globuleux, II un peu plus long, III allongé, assez épais, un peu courbe, brunâtre à l'apex, IV un peu plus long que III, grêle, un peu dilaté dans le tiers apical, V un tiers plus long que IV, faiblement dilaté à l'apex. Labium à pièce basilaire large, très courte, à bord antérieur fortement convexe, palpigère profondément sillonné, à lobes très courts, les internes petits, triangulaires, les externes subaigus, à bord externe peu convexe; palpes à 1er article assez court, 2e presque double du 1er, 3e égal au moins aux deux premiers réunis, très grêle, à peine dilaté vers l'apex. Pubescence presque nulle sur le labium, fine et peu abondante sur les palpes.

THORAX.—Pronotum à bord antérieur assez fortement convexe, bord postérieur convexe au milieu, faiblement sinué sur les côtés; lobes latéraux élevés, à bord inférieur assez régulièrement convexe, à angle antérieur très arrondi, angle postérieur obtus; bords antérieur et latéraux finement rebordés. Coloration roux foncé, un peu rembruni le long des bords antérieur et postérieur; pubescence presque nulle sur le disque, soyeuse et couchée, blanchâtre, sur les lobes latéraux; les bords antérieur et latéraux garnis de poils très courts, raides et espacés.

Mésonotum à bord postérieur fortement convexe au milieu, sinué sur les côtés; bord inférieur des lobes latéraux formant un angle très arrondi un peu en avant du milieu, remontant obliquement en arrière, arrondi en avant.

Métanotum peu convexe en arrière, à lobes latéraux un peu moins élevés qu'au mésonotum, leur bord inférieur droit, un peu oblique en arrière et arrondi en avant.

Dessous du thorax blanchâtre, à pubescence rare. Prosternum assez large, un peu rétréci en arrière et sillonné longitudinalement au milieu. Mésosternum profondément sillonné transversalement au milieu, terminé en arrière en une lame étroite, anguleuse et un peu saillante au sommet, sillonnée au milieu. Métasternum assez large, profondément sillonné longitudinalement. Episternes et épimères complètement cachés, au prothorax, sous le lobe latéral du pronotum, le stigmate également placé sous ce lobe; au mésothorax, l'épisterne est assez grand, très large, à bord inférieur droit, l'épimère forme un bourrelet peu visible, le stigmate est presque entièrement dégagé; au métathorax, épisterne et épimères sont bien visibles, en bourrelets séparés par un profond sillon.

ABDOMEN.—Tergites à bord postérieur régulièrement et faiblement convexe jusqu'au 8e, celui-ci, ainsi que le 9e, un peu plus convexe au milieu et faiblement sinué sur les côtés, 10e à bord postérieur tronqué et un peu concave, bords latéraux obliques, partie médiane déprimée et présentant deux carènes obliques latérales allant de la base aux angles du 11e tergite, celui-ci est assez allongé, arrondi à l' apex, un peu déprimé sur la ligne médiane; valves anales triangulaires, peu aiguës à l'apex. Sternites bombés, à bord postérieur droit, le 9e tronqué à l'apex, portant les styles séparés par un espace égal au moins au double de leur largeur; styles assez grands, comprimés, subaigus à l'apex, assez larges à la base, les bords supérieur et inférieur carénés dans la partie apicale. Cerques assez longs et grêles.

ORGANE COPULATEUR.—L'état de conservation du *type* étudié ne permet pas l'étude des pièces génitales.

PATTES.—Pattes antérieures: hanches comprimées vers la face externe, très allongées transversalement; face externe armée d'une épine assez courte, face interne arrondie, saillante, à bord apical formant une dilatation triangulaire: trochanters allongés, plus larges à l'apex qu'à la base. Fémurs assez forts, un peu renflés à la base, légèrement incurvés, rembrunis vers l'apex ; lobe géniculaire interne armé d'une épine mobile, fine, assez longue. Tibias de même longueur que les fémurs, faiblement comprimés, un peu épaissis à la base, armés en dessous de deux épines externes et d'une épine interne, toutes trois assez fortes, subégales, les externes placées au milieu et un peu au-dessous du quart inférieur, l'interne un peu au-dessous de la supérieure externe ; éperons au nombre de deux, à la face inférieure, l'interne un peu plus long que l'externe. Pubescence roussâtre, fine et abondante sur les fémurs et les tibias. Tarses assez épais, comprimés ; métatarses égalant presque l'ensemble des autres articles, garnis en dessous, jusqu'au tiers apical, d'une double rangée de poils raides, spinuliformes ; 2ᵉ article court, glabre en dessous ; 3ᵉ article plus court que le 2ᵉ, 4ᵉ un peu plus long que les deux précédents réunis, légèrement dilaté à l'apex.

Pattes intermédiaires : hanches inermes, un peu concaves à la face externe, moins allongées transversalement que les hanches antérieures. Fémurs et tibias semblables aux fémurs et tibias antérieurs, les fémurs armés de deux épines apicales, l'interne un peu plus longue que l'externe ; tibias armés : en dessus, de deux épines sur chaque bord, les externes un peu au dessous des internes, la 1ʳᵉ interne très petite ; en dessous, de 3 épines externes situées dans la moitié apicale, la 1ʳᵉ plus forte que les autres, et d'une épine interne placée en face de la médiane externe ; apex armé de 4 éperons, les inférieurs plus longs que les supérieurs. Tarses semblables aux tarses antérieurs.

Pattes postérieures : hanches courtes, aplaties à la face externe, arrondies à la face interne, assez écartées ; trochanters cylindriques, très courts. Fémurs assez courts, épais, sans partie apicale filiforme, à bords inférieurs mutiques ; apex armé d'une petite épine géniculaire interne ; face externe ornée de nombreuses bandes brunes obliques. Tibias un peu plus courts que les fémurs, rembrunis à la base, sillonnés en dessus, armés sur chaque bord supérieur de 25 épines environ, assez petites, serrées et régulières, atteignant presque la base du tibia ; la dernière épine, apicale, séparée de la précédente par un espace un peu plus long que l'espace entre les autres épines ; éperons fort, les externes plus courts que les internes ; inférieurs courbes, spiniformes, intermédiaires doubles des inférieurs, un peu courbés, sillonnés en dedans, supérieurs beaucoup plus longs, droits, crochus à l'apex ; le supérieur interne atteignant l'extrémité de la dent apicale du métatarse. Tarses assez courts, le métatarse presque égal à l'ensemble des autres articles, comprimé, un peu dilaté à l'apex, à bord supérieur à peine arqué et armé de 6 petites épines serrées ; dent apicale forte, dépassant l'apex du 2ᵉ article, un peu dilatée à la base ; face inférieure du métatarse garnie, dans la moitié basale, de deux rangées de fines spinules ; autres articles comme aux pattes antérieures et intermédiaires.

DIMENSIONS.—Dimensions principales du *type* décrit [1] :

Long. du corps ..	17 mm.	Fémur ant.	..	6·5 mm.
,, ,, pronot.	5·5 mm.	Fémur post.	..	14 mm.
Cerques ..	6·5 mm.	Tibia post.	..	13 mm.

[1] La description est faite d'après un seul individu immature ; la taille des adultes doit être de 25 millimètres environ.

Cette espèce est voisine de *R. brunneri* Kirby, mais en diffère par les fémurs postérieurs moins longs que le corps et ses formes en général plus épaisses.

Rhaphidophora acutelaminata, Chopard.

Pl. XIII, figs. 33–40.

Rhaphidophora acutelaminata, Chopard 1916, *Bull. Soc. ent. Fr.*, p. 115.

Upper Rotung, 2000 ft., Abor country (*M. de Courcy*) ; 2 ♂, 1 ♀.

Sukli, E. side of Dawna hills, 2,100 ft. (*F. H. Gravely*) ; 1 ♂, 1 ♀.

Rotung, 1400 ft., Abor country (*S. Kemp*) ; 1 ♂.

Tous ces individus sont immatures, ayant encore une ou plusieurs mues à subir avant de parvenir à l'âge adulte.

Espèce de taille moyenne, de formes très trapues, à coloration roux foncé un peu varié de brun sur le corps, les appendices plus clairs ; pubescence presque nulle sur le corps, peu abondante sur les pattes.

TÊTE.—Occiput peu bombé, brunâtre, luisant ; rostre frontal grand, sillonné sur toute sa longueur mais faiblement échancré à l'extrémité qui est arrondie ; latéralement se trouvent deux grandes taches ocellaires blanc nacré, très nettes. Face large et glabre ; écusson facial un peu bombé, venant finir entre les antennes en un tubercule assez large portant la troisième tache ocellaire ; clypéus trapézoïdal, à côtés échancrés au desus de milieu ; labre un peu plus long que large.

Yeux petits, noirs, aplatis le long de la fossette antennaire, leur bord externe très convexe, bord interne droit. Ocelles blanc nacré, très nets.

Antennes à 1er article assez grand, fortement renflé à la face interne, à bord externe concave ; 2^{e} article assez gros, renflé, 3^{e} article cylindrique, un peu plus long que les suivants ; pubescence très fine, plus abondante en dessus qu'en dessous.

Pièces buccales jaunâtes, assez courtes ; mandibules très fortes à bord interne noir, denté ; maxilles à lacinias tridentés à l'apex, galeas étroits ; palpes grêles à articles I et II courts, III allongé, cylindrique, IV égal à III, très grêle à la base, un peu renflé dans sa moitié apicale, V d'un tiers plus long que IV, un peu dilaté à l'apex ; 2^{e} et 3er articles rayés de brun en dessous. Labium court, à lobes arrondis à l'apex, palpes à 1er article très court, 2^{e} assez allongé, 3^{e} égal aux deux précédents réunis.

THORAX.—Pronotum à bord antérieur un peu convexe, bord postérieur convexe au milieu, faiblement sinué sur les côtés ; lobes latéraux très élevés, à bord inférieur formant un angle peu saillant vers le tiers postérieur, très faiblement sinué dans la partie antérieure ; angle postérieur obtus, arrondi, angle antérieur nul, le bord inférieur largement arrondi en avant ; bords antérieur et latéraux finement rebordés. Coloration roux foncé avec les bords antérieur et postérieur peu distinctement marginés de brun ; pubescence rare sur le disque, soyeuse et couchée, blanchâtre, sur les lobes latéraux.

Mésonotum à bord postérieur assez fortement convexe au milieu, un peu concave latéralement ; bord inférieur des lobes latéraux presque droit, remontant légèrement en arrière, arrondi en avant. Métanotum moins fortement convexe en arrière, lobes latéraux à bord inférieur droit, remontant assez fortement en arrière, légèrement arrondi en avant. Coloration et pubescence comme au pronotum.

Dessous du thorax jaunâtre, à pubescence rare. Prosternum assez large, arrondi en arrière et sillonné longitudinalement; mésosternum plus large que le prosternum, très profondément creusé en gouttière transversalement; partie postérieure saillante, triangulaire à l'apex, sillonnée longitudinalement. Métasternum assez large, très profondément divisé en deux masses presque indépendantes, de forme triangulaire à sommet appliqué sur la plaque mésosternale et un peu prolongé en un petit tubercule saillant, surtout chez le mâle. Episternes et épimères entièrement invisibles au prothorax; au mésothorax, les épisternes sont seuls un peu dégagés; au métathorax, épisternes et épimères sont visibles, mais très courts, le bord inférieur des épisternes droit.

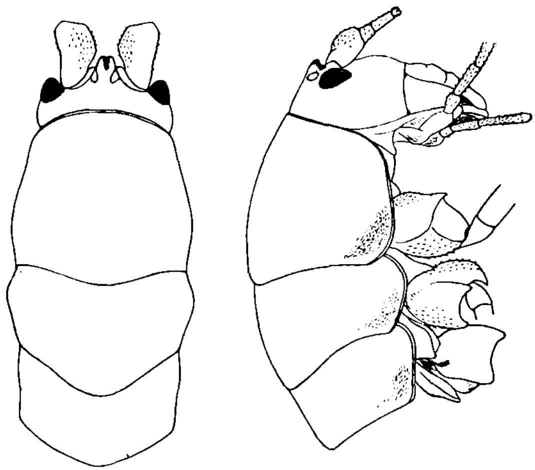

Fig. X.—*Rhaphidophora acutelaminata*, Chop.
Tête et thorax. face dorsale et profil, × 6.

Abdomen.—Tergites réguliers, à bord postérieur faiblement convexe, chez le mâle, jusqu'au 6e, les 7e, 8e et 9e un peu sinués postérieurement, 10e court, à bord postérieur concave, bords latéraux obliques; 11e tergite très allongé, étroit, longuement prolongé en pointe à l'apex; valves anales larges, triangulaires, à côtés un peu concaves, apex arrondi, leur face externe aplatie. Sternites très étroits à la base de l'abdomen, s'élargissant régulièrement et faiblement jusqu'au 9e, celui-ci très grand, montrant deux parties assez distinctes, de longueur égale, la moitié basale ayant à peu près la forme d'un sternite ordinaire, la moitié apicale en triangle très largement arrondi à l'apex; styles assez largement séparés, assez grands, très légèrement aplatis, à bord supérieur droit, bord inférieur un peu convexe, apex subaigu. Pubescence rare sur l'abdomen, fine et abondante en dessous avec quelques longues soies sur le bord postérieur de chaque sternite; styles pubescents; latéralement on voit sur chaque tergite, quelques petits tubercules près du bord postérieur.

Chez la femelle les tergites sont réguliers presqu'au 9^{e} qui, seul, est légèrement sinué au bord postérieur; le 10^{e} tergite est concave au bord postérieur et présente de chaque côté une carène oblique partant de l'angle du 11^{e} tergite et remontant presqu'à la base, le milieu du tergite se trouvant profondément creusé en gouttière; 11^{e} tergite triangulaire, un peu arrondi à l'apex. Sternites larges et bombés, réguliers jusqu'au 7^{e}; plaque sous génitale petite, arrondie avec une petite pointe médiane un peu saillante.[1] Pubescence comme chez le mâle; les tergites ne présentant aucune trace des petits tubercules latéraux signalés chez ce dernier.

Cerques assez courts et épais, à pubescence fine et longues soies sensorielles.

ORGANE COPULATEUR DU MÂLE.—Les pièces génitales du plus âgé des mâles examinés sont bien développées mais entièrement cachées sous la plaque sous-génitale; leur état montre que l'insecte devait être presque adulte; elles forment un ensemble de pièces membraneuses serrées les unes contre les autres où l'on peut distinguer une grande pièce triangulaire supérieure, deux valves latérales bilobées et une pièce médiane inférieure bidentée à l'apex. Le canal éjaculateur débouche au dessus de cette pièce inférieure, son orifice est marqué par deux sillons garnis de poils serrés.

OVISCAPTE.—Cet organe ne peut être décrit d'après les femelles examinées, celles-ci ayant au moins deux mues à subir avant d'être adultes.

PATTES.—Pattes antérieures: hanches très allongées transversalement et peu élevées; leur face externe concave et armée d'une épine assez forte, face interne formant un talon saillant atteignant presque la ligne médiane; trochanters allongés, velus. Fémurs assez courts et forts, un peu comprimés, leur face inférieure légèrement arrondie, inerme; apex armé d'une assez longue épine géniculaire interne. Tibias à peine plus longs que les fémurs, épais, cylindriques, armés de deux éperons apicaux inférieurs et de deux épines assez fortes sur chaque bord inférieur. Pubescence assez abondante sur les fémurs et les tibias. Tarses courts et épais, comprimés, le métatarse égalant à peine l'ensemble des autres articles, les 2^{e} et 3^{e} articles très courts, le 4^{e} assez long, grêle; les trois premiers articles sont munis en dessous d'une large sole glabre, d'aspect membraneux.

Pattes intermédiaire: hanches assez courtes, inermes, beaucoup moins allongées transversalement que les hanches antérieures, plates à la face externe; trochanters courts, cylindriques. Fémurs et tibias semblables aux antérieurs, les fémurs armés de deux épines apicales mobiles, assez longues, surtout l'interne; tibias armés: en dessus de deux épines internes dont la supérieure, petite, placée vers le quart basal et l'inférieure, plus forte, au milieu, et d'une épine externe située un peu au-dessous de l'inférieure interne; en dessous de deux épines externes placées un peu au dessus du milieu et vers le quart apical; apex armé de 4 éperons subégaux. Tarses semblables aux tarses antérieurs.

Pattes postérieures; hanches courtes, arrondies à la face interne et un peu plus

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[1] Cette forme n' est certainement pas celle de l'adulte; chez celui ci, la plaque sous-génitale doit être triangulaire comme dans les espèces voisines, mais les côtés restent peut-être légèrement convexes ou sinués.

distantes entre elles que les hanches antérieures. Fémurs relativement courts et épais, sans partie filiforme, à bords inférieurs mutiques, et armés d'une seule épine géniculaire interne. Tibias un peu plus courts que les fémurs, arrondis et mutiques en dessous, armés en dessus, sur chaque bord, de 20 à 25 épines assez fortes, régulières et venant presque jusqu'à la base du tibia, la dernière étant tout à fait apicale ; éperons forts, crochus à l'apex, les inférieurs courbes, courts, subégaux, l'intermédiaire externe à peine plus long que l'inférieur, l'interne au moins double de l'inférieur interne, les deux supérieurs très longs, l'interne dépassant l'extrémité de la dent apicale du métatarse. Tarses assez courts ; métatarse égal aux autres articles réunis, très comprimé, à bord supérieur fortement arqué et armé de 4 à 6 épines couchées, apex terminé en une très forte dent atteignant l'extrémité du 2e article ; 2e et 3e articles très courts, presque égaux, 4e article grêle, allongé, un peu dilaté à l'apex.

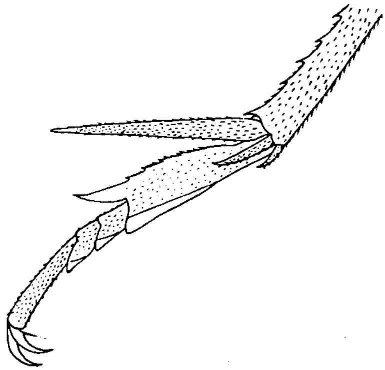

FIG. XI.—*Rhaphidophora acutelaminata*, Chop. Extrémité du tibia postérieur et tarse (face interne), × 5.

DIMENSIONS.—Les individus décrits n'ayant pas atteint l'âge adulte ont des dimensions un peu inférieures à celles que l'on doit considérer comme normales pour l'espèce ; la taille doit être moyenne et atteindre environ 22 à 25 mm. Les principales proportions sont données ci dessous d'après deux individus de Sukli :

	♂	♀		♂	♀
Long. du corps ..	19 mm.	18·5 mm.	Fémur ant. ..	7 mm.	7 mm.
„ du pronot.	6 mm.	6·5 mm.	Fémur post. ..	17 mm.	16·5 mm.
Cerques ..	4 mm.	5 mm.	Tibia post. ..	16 mm.	15 mm.

Cette espèce est remarquable par ses métatarses postérieurs à bord supérieur fortement convexe et par la valve anale supérieure des mâles longuement prolongée. Ce dernier caractère est moins prononcé chez les jeunes individus. Une jeune femelle, provenant de Sukli, ayant 13 mm. de long et l'oviscapte de 1·5 mm. seulement, montre des appendices styliformes très nets à l'extrémité des valves supérieures de l'oviscapte.

Gen. **Paradiestrammena**, nov.

Diestrammena, Brunner (*partim*), *Verh. zool. bot. Ges. Wien*, XXXVIII [1888], p. 298.

Aptère, coloration en général roussâtre varié de brun, pubescence peu abondante. Tête allongée ; occiput court, vertex prolongé en un rostre sillonné et séparé au sommet en deux petits cônes aigus plus ou moins écartés ; palpes maxillaires très longs et grêles, à 5e article à peine dilaté au sommet, égalant presque les deux articles précédents réunis ; antennes très longues, rapprochées à la base ; yeux petits, allongés, ocelles réduits à deux taches situées à la base du rostre frontal. Pronotum très arrondi, à bord postérieur plus ou moins convexe, lobes latéraux élevés. Abdomen ovalaire, à 7^{e} tergite prolongé ou non chez les mâles, valves anales et plaque sous-génitale de forme variable ; cerques très longs, atteignant souvent, chez les femelles, la longueur de l'oviscapte. Styles nuls chez les mâles. Pattes longues et grêles ; hanches antérieures armées d'une longue épine dirigée en bas ; fémurs antérieurs portant deux épines apicales, l'externe longue et mobile, l'interne très courte, fixe ; fémurs intermédiaires portant deux épines apicales longues et mobiles ; tibias postérieurs armés en dessus, sur chaque bord, d'épines presque régulières, au nombre de 15 à 35, laissant un espace inerme aux deux extrémités, et présentant une petite épine apicale de chaque côté ; vers le quart apical, une seule épine est plus forte que les autres et présente à sa base un faible sillon. Oviscapte comprimé, à valves inférieures armées vers l'apex d'une douzaine de denticulations larges, plates, à angle postérieur prolongé et aigu.

La création d'un genre nouveau me paraît nécessaire par suite de la mise en synonymie du genre *Tachycines* d'Adelung qui résulte de la constatation de l'identité spécifique du *Tachycines asynamorus* Ad. et de *Diestrammena marmorata* de Haan. C'est à la suite d'une correspondance échangée avec Mr. Morgan Hebard, de Philadelphia, que je me décide à adopter les vues de ce savant Orthoptèriste ; Mr. Hebard et moi-même avons pu examiner récemment des individus de *Diestrammena marmorata* du Japon et, les comparant à des *Tachycines* d'Europe et d'Amérique, constater leur parfaite identité. Mais comme j'admets, d'autre part, la valeur générique du caractère indiqué par Adelung pour l'armature des tibias postérieurs, il devenait nécessaire de créer un genre dans lequel entreront toutes les espèces à tibias postérieurs portant des épines relativement peu nombreuses (15 à 35) et presque régulières. Le genre *Diestrammena* Br. prend par ailleurs la priorité sur *Tachycines* Ad. et comprendra les espèces à tibias postérieurs pourvus d'épines très nombreuses (50 à 80) et disposées en séries croissantes très nettes de 2 à 7 épines.

Les espèces cavernicoles de *Paradiestrammena* étudiées ici forment un petit groupe très homogène duquel je n'ai pas voulu détacher *P. brevifrons* Chop., bien que cette espèce habite une région un peu différente. Le tableau ci-dessous permettra de les déterminer :

1. Fémurs postérieurs mutiques en dessous ; ♂, plaque sous-génitale grande, arrondie, épiphalle cylindrique, à extrémité libre en forme de croissant ; ♀, plaque sous-génitale triangulaire, oviscapte court à valves supérieures un peu excavées près de l'apex .. .. *P. feai* Chop.

– Fémurs postérieurs armées presque toujours d'une ou plusieurs petites épines sur le bord inférieur interne .. .. .. 2.

2. Rostre frontal court, tronqué et faiblement incisé à l'apex ; ♂, plaque sous-g nitale grande, tronquée à l'apex, épiphalle assez grand, aplati, trapézoïde à angles arrondis ; ♀ plaque sous-génitale arrondie, cerques plus courts que l'oviscapte .. .. *P. brevifrons* Chop.

– Rostre frontal profondément divisé, formant deux tubercules coniques, aigus .. .. 3.

3. Coloration roussâtre assez uniforme, thorax un peu luisant, avec les tergites bordés de brun postérieurement ; ♀ plaque sous-génitale à 5 lobes apicaux, cerques plus courts que l'oviscapte (mâle inconnue) .. *P. annandalei* Kirby.

– Coloration moins uniforme ; pronotum marqué de deux grandes taches jaunâtres très nettes, près du bord antérieur et présentant, ainsi que le mésonotum une bande brune médiane ; tergites thoraciques et trois premiers tergites abdominaux très luisants ; ♀ plaque sous-génitale trilobée à l'apex, le lobe médian plus ou moins échancré au sommet, cerques aussi longs ou plus longs que l'oviscapte .. *P. gravelyi* Chop.

Paradiestrammena feai, Chopard.

Pl. XIV, figs. 41–48.

Diestrammena feai, Chopard 1915, *Bull. Soc. ent. Fr.*, p. 278.

Diestrammena unicolor, Griffini 1912, *Bull. Mus. Hist. nat. Paris*, p. 4.—Annandale, Brown & Gravely 1913, Journ. *As. Soc. Bengal*, no. 10. p. 405, 413.—Griffini 1914, *Atti Soc. it. Sc. nat.*, p. 27.

Diestrammena unicolor (*partim*), Brunner 1888, *Verh. zool.-bot. ges. Wien*, p. 298.

Diestrammena annandalei ? (*partim*), Griffini 1915. *Atti Soc. it. Sc. nat.*, p. 99.

Farm caves, near Moulmein (*C. Woglum*, 1-i-1911) ; nombreux individus.—Farm caves (*T. B. Fletcher*, 14-ix-1914), in dark parts, 2 ♂, 3 ♀ immature.—Farm caves (*F. H. Gravely*, 17-xi-11, 4-xii-11), nombreux individus.—Dhammethat, Gaying R., Amherst Distr. (*F. H. Gravely*, 2-xii-11), 2 ♂, 6 ♀.

Espèce de taille assez faible, à coloration jaune roussâtre avec la face et les fémurs postérieurs fasciés de brun, et les tergites thoraciques et abdominaux marginés de brun ; pubescence presque nulle sur le corps, rare sur les pattes et les antennes.

Tête.—Occiput peu bombé, un peu rembruni ; front court, déclive, terminé par un rostre formant deux tubercules coniques, bruns, séparés l'un de l'autre par un espace égal au moins à la moitié de leur propre largeur ; le front et le vertex sont assez fortement ponctués et garnis de poils couchés ; il existe un sillon longitudinal, très fin, naissant entre les tubercules et se prolongeant jusque sur l'occiput. Face allongée, étroite, ornée de deux bandes brunes descendant de l'angle interne des fossettes antennaires et de deux taches sous les yeux ; écusson facial assez large, prolongé entre les antennes en un étroit tubercule allongé ; clypéus trapézoïdal à bords latéraux rétrécis vers le milieu, les angles supérieurs bruns formant l'extrémité inférieure de la fascie brune de la face. Labre plus long que large, à bords latéraux faiblement convexes, garnis de longs poils.

Yeux très petits, allongés, étroits, leur bord interne un peu concave, leur bord externe assez fortement convexe, les angles supérieurs et inférieurs assez aigus.

Antennes rousses, à 1er article grand, un peu déprimé, légèrement renflé à la face interne, près de la base ; 2^{e} article cylindrique à peine moitié aussi long que le 1er ; 3^{e} article plus long que le 2^{e}, grêle, dilaté à la base ; à partir du 4^{e}, les articles sont régulièrement cylindriques, au moins une fois et demie aussi longs que larges ; pubescence dressée, peu abondante, surtout sur les deux premiers articles.

Pièces buccales : mandibules triangulaires, brunes à l'apex et au bord interne, bidentées à l'apex ; leur bord externe très faiblement concave près de la base, puis fortement convexe à partir du tiers apical.

Hypopharynx n'atteignant pas l'extrémité du labium, incisé au milieu du bord apical.

Maxilles à pièces basilaires anguleuses au bord externe ; lacinias armés de deux dents apicales aiguës dont la supérieure beaucoup plus longue que l'inférieure et d'une dent antéapicale très fine, courbe, un peu plus courte que la 2e apicale ; bord externe convexe, glabre, sinué à la base ; bord interne presque droit, garni de longues soies ; galeas étroits, arrondis à l'apex. Palpes longs et grêles, à article I court, cylindrique, II un peu plus long, dilaté à l'apex, III long et grêle, IV égal à III, très grêle sur les deux premiers tiers, brusquement dilaté ensuite, V presque double de IV, très grêle, un peu incurvé, arrondi et à peine dilaté à l'apex ; pubescence presque nulle sur les deux premiers articles, plus abondante sur le 3e et surtout sur les deux derniers.

Labium assez allongé, à plaque basilaire un peu plus longue que large, à côtés droits ; mentum environ deux fois aussi large que long à bord antérieur sinué ; palpigère profondement divisé, presque carré dans son ensemble ; lobes externes

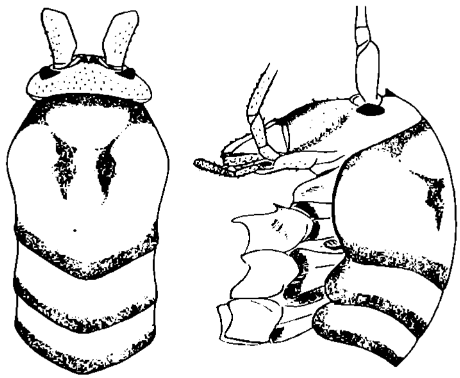

FIG. XII.—*Paradiestrammena feai*, Chop.
Tête et thorax, face dorsale et profil, × 6.

arrondis, presque aussi longs que le labium, lobes internes courts, triangulaires ; pubescence rare sur le labium, assez abondante sur les lobes externes. Palpes longs, à 1er article très court, dilaté, 2e article assez long, grêle et un peu incurvé, 3e article égal aux deux premiers réunis, un peu dilaté à l'apex ; pubescence rare sur les deux premiers articles, assez abondante sur le 3e.

THORAX.—Pronotum un peu plus long que large, à bord antérieur faiblement convexe, bord postérieur très fortement convexe dans la partie médiane, oblique latéralement, lobes latéraux élevés, à bord inférieur assez fortement convexe et un peu sinué près de l'angle postérieur ; angles très arrondis, obtus ; disque très bombé, testacé roussâtre, lisse ; bords antérieur et postérieur assez largement et nettement bordés de brun ; il existe, en outre, une tache brune triangulaire sur les côtés du bord antérieur et une tache indécise de chaque côté du milieu du disque ; bords latéraux, seuls, finement rebordés.

Mésonotum assez long, à bord postérieur très convexe au milieu, un peu concave sur les côtés, à lobes latéraux arrondis ; bordé largement et nettement de brun latéralement et postérieurement.

Métanotum plus court que le mésonotum et à bord postérieur moins convexe, bordé de brun comme lui.

Dessous du thorax jaunâtre, en grande partie membraneux, à pubescence rare.

Prosternum large, présentant seulement une plaque chitineuse médiane, transversale, et deux brides qui contournent les cavités cotyloïdes ; en avant de celles-ci, sur le côté du cou, se trouvent deux tubercules assez volumineux ; épisternes et épimères courts, en forme de bourrelets brunâtres, séparés par un profond sillon ; stigmate grand, en partie caché sous le pronotum.

Mésosternum portant une grande plaque chitineuse rectangulaire, profondément sillonnée transversalement et percée de trois invaginations s'enfonçant dans les tissus ; épisternes grands, obliques, à bord antérieur caréné, bord postérieur brun, un peu dilaté en une expansion qui recouvre un peu la hanche ; épimères formant un bourrelet brunâtre en grande partie caché sous les épisternes.

Métasternum assez large, presque entièrement membraneux, présentant deux bourrelets obliques, convergents en arrière ; épimères et épisternes à peu près de même forme qu'au mésothorax, mais plus courts et le bord inférieur des épisternes non dilaté.

Abdomen.—Abdomen ovalaire, roussâtre avec le bord postérieur des tergites rembruni ; chez le mâle, les tergites sont régulièrement arqués jusqu'au 9^e qui est un peu plus fortement convexe, au milieu, que les précédents ; le 10^e est tronqué, à bord postérieur un peu concave et angles latéraux aigus et saillants ; 11^e tergite assez grand, un peu allongé, arrondi au sommet ; chez la femelle, les tergites sont assez fortement convexes depuis le 7^e qui est légèrement émarginé à l'apex ; le 10^e tergite est semblable à celui du mâle mais à angles un peu moins saillants ; 11^e tergite en triangle allongé, arrondi au sommet et sillonné longitudinalement.

Dessous de l'abdomen jaunâtre, à pubescence rare et dressée ; sternites très étroits à la base, s'élargissant peu à peu, dans les deux sexes ; plaque sous-génitale du mâle (9^e sternite) grande, très largement arrondie, styles nuls. Chez la femelle, le 7^e sternite est beaucoup plus grand que les précédents et la plaque sousgénitale est petite, triangulaire, à côtés un peu convexes, à apex peu aigu.

Cerques longs, surtout chez la femelle, à pubescence peu abondante et soies très fines.

Organe copulateur du mâle.—En dessous des valves anales, on voit un épiphalle assez volumineux, de forme cylindrique, presque entièrement plongé dans le tissus membraneux de la région périgénitale ; l'extrémité supérieure, seule, se trouve un peu dégagée et a la forme d'un large croissant chitineux à bord externe tranchant ; en dehors de l'épiphalle, l'ensemble de l'organe copulateur est entièrement membraneux et présente une masse centrale et, de chaque côté, deux prolongments superposés, recourbés ; toute la surface de l'organe est couverte de petites spinules portées sur un tubercule arrondi ; vers le centre, au point où débouche le canal éjaculateur, ces spinules sont beaucoup plus fines, sans tubercule basal, et extrêmement serrées ; sur la partie non libre de l'épiphalle se trouvent également quelques petites épines, la partie libre porte de nombreux petits tubercules.

OVISCAPTE.—Oviscapte relativement court, atteignant environ les deux tiers de la longueur du corps, testacé roux, luisant; face externe assez large, la valve supérieure large à la base, puis assez brusquement rétrécie et un peu incurvée, à bords parallèles jusque vers l'apex; tout près de l'apex, le bord supérieur s'incurve brusquement, formant une pointe aiguë, recourbée; valve inférieure à bord inférieur presque droit, apex aigu; vers l'apex ce bord est armé de 11 denticulations plates, larges, munies d'une petite dent peu saillante dans l'angle inférieur. A la face interne, la valve inférieure se montre un peu élargie vers l'extrémité; la valve interne, étroite, atteint presque l'apex de l'oviscapte; toutes deux sont garnies de fines spinules.

PATTES.—Pattes antérieures: hanches longues, à face interne glabre, un peu concave dans sa partie postérieure qui reçoit le fémur; en avant de cette partie concave se trouve une arête saillante qui porte une épine rousse, forte mais peu aiguë, un peu au-dessus du milieu; le bord inférieure forme un lobe saillant à la face interne et un autre, plus petit mais plus aigu, dans le prolongement de la carène externe; face interne velue et arrondie. Trochanters velus et assez longs en dessous, très courts en dessus. Fémurs sillonnés en dessous, un peu renflés à la base, à pubescence brune, peu abondante; apex armé, au bord externe, d'une longue épine mobile, insérée sur le lobe géniculaire, au bord interne, d'une petite épine brune fixe. Tibias un peu comprimés, à pubescence rare en-dessus, abondante et couchée en dessous, armés au bord inférieur externe de deux épines assez longues, situées à égale distance des deux extrémités et au bord interne d'une seule épine, courte, placée un peu au-dessus de l'inférieure externe; l'apex est armé de deux éperons inférieurs, longs, surtout l'externe, d'un seul éperon supérieur externe, très court, et d'une petite épine médiane inférieure. Tarses comprimés, grêles, velus; métatarses plus longs que les autres articles réunis, 2e article égal au tiers du métatarse, tous deux garnis en dessous de deux rangées de poils raides, spinuliformes; 3e article court, caréné et glabre en dessous; 4e article grêle.

Pattes intermédiaires: hanches un peu plus courtes que les hanches antérieures, à lobes apicaux moins développés, inermes. Fémurs et tibias ayant la même forme que les antérieurs, mais les fémurs armés de deux longues épines apicales égales, un peu crochues, les tibias armés à l'apex comme les antérieurs, mais présentant aux bords inférieurs une seule épine externe et une petite épine interne, toutes deux insérées vers le tiers apical du tibia. Tarses semblables aux tarses antérieurs.

Pattes postérieures: hanches courtes et épaisses, à face externe glabre, bord apical formant seulement un angle saillant à la face interne, trochanters courts. Fémurs renflés à la base, peu velus, ornés de quelques taches brunes à la face externe, leurs bords inférieurs inermes; apex armé de deux petites épines brunes au bord supérieur de chaque lobe géniculaire. Tibias un peu plus longs que les fémurs, arrondis et mutiques en dessous, sillonnés en dessus et armés d'épines en nombre très variable (15 à 30) et assez irrégulièrement espacées; il existe, néanmoins, toujours un espace mutique entre l'épine apicale de chaque bord et la précédente et l'une des épines, située vers le quart apical est sensiblement plus forte que toutes les autres; éperons grands et velus, les 3 internes plus longs que les externes correspondants; les inférieurs sont assez courts, courbes, les intermédiaires et supérieurs longs, droits et un peu crochus au bout; le supérieur interne atteignant l'extrémité du métatarse. Tarses semblables aux tarses des deux autres paires, mais avec le métatarse armé d'une épine apicale, le 2e article caréné en dessous sur la moitié de sa longueur.

DIMENSIONS.—Les dimensions sont peu variables chez les individus bien adultes; les plus grandes variations observées sur le nombre assez considérable d'individus examinés n'excèdent pas 2 millimètres. Les dimensions principales sont les suivants:

	♂	♀		♂	♀
Long. du corps ..	12 mm.	13 mm.	Fémur ant. ..	8·5 mm.	9 mm.
„ „ pronot. ..	5·5 mm.	5·7 mm.	Fémur interm. ..	8 mm.	8·5 mm.
Cerques ..	7 mm.	8 mm.	Fémur post. ..	15·5 mm.	17 mm.
Oviscapte ..	..	8 mm.	Tibia post. ..	16 mm.	18 mm.

HABITAT.—L'habitat de cette espèce est, suivant moi, strictement limité aux cavernes de la basse Birmanie qui sont citées plus haut.

Les premiers individus de *P. feai* rapportés de Moulmein par L. Fea furent décrits par Brunner von Wattenwyl sous le nom de *D. unicolor*; mais, dans la description, l'auteur réunissait des insectes provenant de Vladivostock et de Pékin et ceux de Moulmein. Il s'agit en rèalité de deux espèces bien différentes et la description du mâle peut seule, dans une certaine mesure, s'appliquer aux *Paradiestrammena* de Birmanie. Quant à la femelle, malgrè la brièveté de la diagnose, il n'est pas douteux qu'elle appartienne à une espèce beaucoup plus grande et à oviscapte relativement plus long. Le nom de *D. unicolor* doit, de toute facon, être appliqué à l'espèce de Chine car, dans son tableau des espèces, précédant les diagnoses, Brunner indique uniquement comme répartition géographique de cette espèce "Species chinensis."

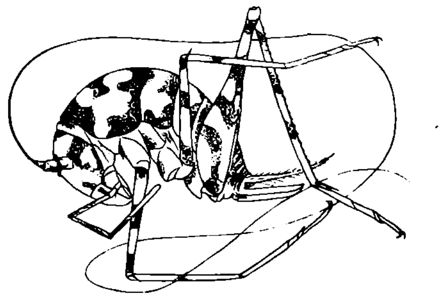

FIG. XIII.—*Paradiestrammena feai*, Chop. Ensemble d'une jeune femelle, montrant la pigmentation, × 6.

Il est à noter que les jeunes individus montrent une pigmentation beaucoup plus marquée que chez les adultes, leur corps étant parsemé de grandes taches brunes irrégulières; cette pigmentation diminue peu à peu mais ne disparaît complètement qu'à la dernière mue.

Paradiestrammena brevifrons, Chopard.

Pl. XIV, figs. 49–55.

Diestrammena brevifrons, Chopard 1916, *Bull. Soc. ent. Fr.*, p. 113.
Diestrammena annandalei ? (partim), Griffini 1915. *Atti Soc. it. Sc. nat.*, p. 99.
Maosmai cave. Cherrapunji. Assam, 4200 ft. (*S. W. Kemp*, 3-x-14), 6 ♂, 5 ♀.

Espèce de taille moyenne, entièrement jaune roussâtre avec le bord postérieur des tergites thoraciques et abdominaux assez étroitement et nettement marginé de brun ; pattes concolores, antennes un peu rembrunies. Pubescence assez longue et couchée sur le dos, très caduque, formée de poils écailleux, plus fine et dressée sous le corps.

TÊTE.—Occiput peu bombé ; front court, terminé par un rostre brunâtre, court, largement mais peu profondément incisé, formant deux tubercules larges, tronqués à l'apex, à la base desquels se trouve une tache ocelliforme jaunâtre. Face large, rousse avec le clypéus et une baude médiane sur l'écusson facial plus clairs et une bande brune très vague sous chaque oeil, écusson facial lisse, large et peu bombé, venant finir en un tubercule très étroit entre les fossettes antennaires qui se touchent presque ; clypéus presque aussi large à son bord inférieur qu'au bord supérieur, tous deux légèrement convexes ; bords latéraux rétrécis bien en dessous du milieu près de l'angle

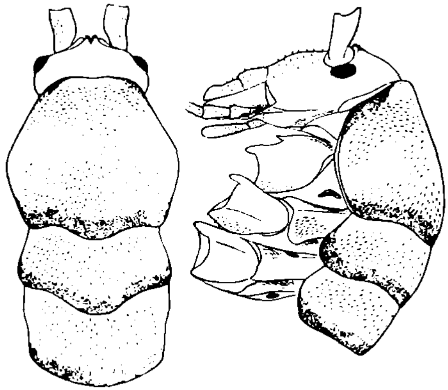

FIG. XIV.—*Paradiestrammena brevifrons*, Chop.
Tête et thorax, face dorsale et profil × 6.

inférieur ; disque assez fortement caréné au milieu, transversalement, dans son ensemble moitié moins haut que large. Labre aussi large que long, à bords latéraux convexes garnis de longs poils, apex légèrement incisé ; face inférieure (épipharynx) garnie de deux rangées de longs poils couchés et présentant une petite fossette apicale à pubescence feutrée.

Yeux assez petits, bien pigmentés, étroits, situés tout de suite derrière la fossette antennaire ; bord externe fortement convexe, bord interne légèrement concave ; surface très bombée, à facettes assez grosses.

Antennes rousses, atteignant environ huit fois la longueur du corps ; 1er article grand, assez fortement dilaté à l'apex antéro-postérieurement ; vu de dessus, son bord externe est légèrement sinué, son bord interne droit depuis l'apex jusqu'au quart basal, puis brusquement incliné en dedans ; 2^{e} article moins grand que le 1er, un peu étranglé au milieu ; 3^{e} article grêle, assez allongé, un peu dilaté à la base, 4^{e} un peu plus long que les suivants qui sont régulièrement cylindriques, environ une fois et demie aussi longs que larges. Pubescence dressée, rare, surtout sur les trois premiers articles.

Pièces buccales : mandibules fortes, à bord externe fortement convexe dans la moitié apicale, bord interne noirâtre à surface masticatrice formée de deux crêtes dentées, apex armé de deux dents courtes et fortes.

Hypopharynx très large, plus court que le labium, à bords latéraux très convexes, apex assez fortement incisé.

Maxilles à pièces basilaires saillantes, formant un angle arrondi au bord externe ; lacinias armés à l'apex de trois dents longues et aiguës, l'inférieure un peu écartée des deux apicales, grêle et courbée ; bord interne droit, muni de longs poils raides, peu abondants ; galeas étroits, arrondis à l'apex. Palpes longs et assez grêles, à article I court, dilaté à l'apex, II un peu plus long que I et de forme analogue, III long, cylindrique, assez épais, IV égal à III en longueur, grêle à la base, régulièrement et faiblement dilaté depuis le milieu, V double de IV, grêle et un peu incurvé, faiblement dilaté vers l'apex qui est arrondi ; pubescence presque nulle sur les deux premiers articles, assez abondante sur les suivants, et comprenant des poils couchés, noirâtres, très caducs, et des poils dressés, très fins, blonds.

Labium à pièce basilaire large, à côtés un peu sinués, bord supérieur concave ; mentum large, à bord supérieur fortement sinué ; palpigère plus long que large, profondément divisé ; lobes externes presque moitié plus courts que le mentum, légèrement tronqués à l'apex, lobes internes triangulaires, très courts. Palpes assez longs, à article I court, fortement dilaté, II un peu plus long, assez épais, III égal aux deux premiers réunis, un peu dilaté à l'apex et arrondi. Pubescence presque nulle sur les pièces du labium qui sont testacées, luisantes, sauf sur les lobes externes qui portent une pubescence dressée, assez abondante ; les palpes sont également pubescents, surtout le troisième article.

THORAX.—Pronotum très large, à bord antérieur convexe mais légèrement incisé au milieu, bord postérieur très fortement convexe au milieu, un peu sinué latéralement ; lobes latéraux élevés, à bord inférieur convexe en avant, droit en arrière ; angle antérieur très obtus, angle postérieur droit mais arrondi ; disque testacé roux ; bord postérieur assez largement et nettement bordé de brun, bord antérieur rembruni surtout sur les lobes latéraux, concolore au milieu. Pubescence assez abondante, formée de poils couchés, noirâtres, dirigés en avant ; bord inférieur des lobes latéraux finement rebordé.

Mésonotum assez long, à bord postérieur fortement convexe au milieu, un peu concave sur les côtés ; lobes latéraux élevés, à bord inférieur fortement convexe en arrière, oblique en avant ; bord postérieur très nettement marginé de brun, lobes latéraux brunâtres.

Métanotum de même longueur que le mésonotum, comme lui bordé de brun postérieurement, bord postérieur légèrement convexe, bord inférieur des lobes latéraux largement arrondi.

Dessous du thorax jaunâtre, à pièces sclérifiées très réduites, à pubescence rare.

Prosternum large, présentant une grande pièce en U qui contourne la cavité cotyloïde et vient se relier à l'épisterne de chaque côté ; en avant d'elle, de chaque côté du cou, un repli, légèrement sclérifié, forme une sorte de tubercule assez volumineux. Episternes et épimères très courts, presque entièrement cachés sous le lobe latéral prothoracique ; stigmate grand, s'ouvrant dans la membrane en arrière de l'épimère, et en partie engagé sous le pronotum.

Mésosternum portant une plaque rectangulaire courte, profondément sillonnée longitudinalement et percée de trois invaginations qui donnent naissance aux apodèmes ; épisternes grands, à bord inférieur dilaté ; épimères étroits en bourrelet ; stigmate ovale.

Métasternum large en avant, assez étroit en arrière, les hanches postérieures étant cependant largement séparées ; épisternes et épimères obliques, assez larges, en bourrelets.

Abdomen.—Abdomen ovalaire, faiblement caréné longitudinalement dans sa partie apicale ; tergites roux testacé, rembrunis au bord postérieur ; chez le mâle, les tergites sont réguliers, à bord postérieur faiblement convexe, jusqu'au 9ᵉ qui est presque anguleux en arrière ; 10ᵉ tergite large, à bord postérieur tronqué, légèrement concave au milieu, angles un peu arrondis ; 11ᵉ assez grand, triangulaire, à bords un peu convexes, apex un peu arrondi et épaissi en un petit bourrelet luisant ; la forme des tergites est tout à fait semblable chez la femelle, mais le 10ᵉ est un peu moins large au bord postérieur et à angles plus arrondis.

Dessous de l'abdomen jaunâtre, à pubescence dressée, rare ; chez le mâle, les sternites sont fortement convexes, en forme de bourrelets, un peu plus larges à l'extrémité qu'à la base ; les 1ᵉʳ et 2ᵉ sont engagés entre les hanches postérieures, mais sont assez larges, vu l'écartement de celles-ci ; 3ᵉ à 7ᵉ à peu près réguliers, s'élargissant faiblement en arrière, 8ᵉ court, moins long et moins convexe que les précédents, 9ᵉ (plaque sous-génitale) presque aussi long que les deux précédents réunis, un peu renflé latéralement à la base, largement tronqué à l'apex, à angles arrondis. Chez la femelle, les plaques sternales sont très petites, bombées, jusqu'à la 4ᵉ, les 5ᵉ et 6ᵉ sont plus grandes, trapézoïdales, subcarénées transversalement, la 7ᵉ est grande, ovalaire, bombée au milieu, luisante ; la plaque sous-génitale est assez grande, large, arrondie en demi-cercle.

Cerques assez courts dans les deux sexes (plus courts que l'oviscapte chez la femelle), à pubescence rare, fine et assez longue.

Organe copulateur du mâle.—Les pièces génitales font grandement saillie au-delà de la plaque sous-génitale ; elles sont entièrement membraneuses sauf l'épiphalle ; celui-ci, assez grand, est placé sous les valves anales ; il est aplati, en forme d'écusson trapézoïde dans son ensemble, mais à angles très arrondis et à côtés un peu concaves, la plus large base se trouvant en avant ; l'appareil copulateur forme un complexe présentant, de chaque côté, un grand prolongement membraneux incurvé, venant se croiser, en arrière, avec la pièce symétrique ; à la face supérieure se trouvent une grande masse centrale triangulaire, arrondie à l'apex, et, entre cette masse et la grande valve incurvée, un petit prolongement arrondi ; à la face inférieure, on voit seulement deux petits tubercules près de la ligne médiane ; cet ensemble est presque complètement couvert de poils raides portés sur des petits tubercules arrondis, surtout abondants vers le milieu de la face supérieure de la masse triangulaire médiane; l'épiphalle est lui-même couvert de petits tubercules pilifères. Le canal éjaculateur débouche dans la partie inférieure de l'ensemble, entre les deux tubercules signalés; près de son orifice, il présente quatre replis longitudinaux garnis de longs poils, un peu épais, extrêmement serrés et dirigés en arrière.

Oviscapte.—Oviscapte court, dépassant peu la moitié de la longueur du corps, épais à la base, presque droit; valve supérieure un peu plus courte que l'inférieure très large à la base, à bord supérieur un peu renflé près de la base, puis presque droit jusqu'à l'apex, bord inférieur faiblement convexe, apex aigu; valve inférieure très légèrement incurvée, à apex peu aigu, son bord inférieur armé, dans la partie apicale, de 12 denticulations larges, aplaties, portant une dent peu aiguë et peu saillante à leur angle inférieur. Valve interne très étroite, atteignant presque l'extrémité de l'oviscapte.

Pattes.—Pattes antérieures: hanches assez longues, à face externe glabre, concave; bord antéro-externe saillant, armé un peu au dessus du milieu d'une petite épine brune; face interne velue, arrondie, présentant au bord apical un lobe très saillant, anguleux; un autre petit lobe se trouve dans le prolongement de la carène antéro-externe. Trochanters assez longs, un peu dilatés à l'apex. Fémurs un peu renflés à la base, sillonnés et glabres en dessous, peu velus en dessus; apex armé à la face externe, d'une longue épine mobile, jaune, grêle un peu courbe, à la face interne, d'une très petite épine fixe, à peine visible. Tibias un peu plus longs que les fémurs, légèrement comprimés, armés en dessous, au bord externe, de deux épines assez longues, situées à égale distance des extrémités du tibia; apex présentant deux éperons inférieurs assez longs, surtout l'interne, et un petit éperon supérieur externe; entre les deux éperons inférieurs se trouve une petite épine médiane. Tarses comprimés, grêles; métatarses très allongés, plus longs que les autres articles réunis, non carénés en-dessous et munis, sur toute leur longueur, d'une rangée de soies spinuliformes; 2e article égal au tiers du métatarse environ, caréné en dessous; 3e article court, également caréné: 4e article grêle, presque égal aux deux précédents réunis.

Pattes intermédiaires: hanches de forme semblable à celle des hanches antérieures, inermes. Fémurs et tibias semblables aux fémurs et tibias antérieurs, mais les fémurs présentant deux longues épines apicales mobiles et les tibias étant inermes en dessous à l'exception de la petite épine apicale médiane et des éperons qui sont semblables aux éperons antérieurs mais au nombre de 4. Tarses comme aux pattes antérieures.

Pattes postérieures: hanches épaisses, à face externe aplatie, face interne en bourrelet un peu anguleux; trochanters très courts. Fémurs bien renflés à la base, d'un roux uniforme à la face externe, à bords inférieurs inermes; apex armé d'une très petite épine au bord supérieur du lobe géniculaire interne. Tibias un peu plus longs que les fémurs, grêles, sillonnés en dessus et armés sur chaque bord de 30 épines environ, assez fortes, brunes à l'apex et dont la dernière est séparée de la précédente par un petit espace mutique; l'une des épines (la 7e environ à partir de l'apex) est plus forte que les autres et un peu séparée des suivantes; éperons grands, les internes plus longs que les externes correspondants; inférieurs courts, courbes et glabres, spiniformes; intermédiaires presque triples des inférieurs, droits, velus, crochu sà l'apex, supérieurs presque doubles des intermédiaires et de même forme qu'eux; l'éperon supérieur interne est nettement plus court que le métatarse. Tarses longs, semblables aux tarses des autres paires, mais le métatarse armé d'une petite épine apicale.

DIMENSIONS.—Les mâles sont un peu plus petits que les femelles; les dimensions générales s'écartent fort peu de celles indiquées ci-dessous:

	♂	♀		♂	♀
Long. du corps	11·5 mm.	16 mm.	Fémur ant. ..	8 mm.	9.5 mm.
,, ,, pronot.	4 mm.	5 mm.	Tibia ant. ..	9 mm.	10·5 mm.
Antennes ..		env. 110 mm.	Fémur interm. ..	7 mm.	8·5 mm.
Cerques ..	6·5 mm.	8 mm.	Fémur post. ..	15·5 mm.	18 mm.
Oviscapte ..	....	9 mm.	Tibia post. ..	17·5 mm.	20 mm.

Cette espèce ressemble un peu à *P. feai* par sa coloration assez uniforme, ses pattes concolores et ses fémurs postérieurs inermes en dessous; elle en diffère très nettement par la forme de l'épiphalle du mâle, de l'oviscapte et de la plaque sous-génitale de la femelle. Le rostre frontal, tronqué à l'apex, l'éloigne à la fois de *P. feai* et de *P. annandalei* et *P. gravelyi*. L'armature des tibias antérieurs et intermédiaires est plus faible que dans les trois autres espèces.

Paradiestrammena annandalei, Kirby.

Pl. XIV, figs. 56–58.

Diestrammena annandalei, Kirby 1908, *Rec. Ind. Mus.*, p. 43.

Limestone caves in hills near Biserat, Jalor, Siamese Malay States (*Annandale* and *Robinson*).

Espèce de taille moyenne, à coloration roussâtre assez uniforme, les tergites thoraciques et abdominaux marginés de brun; pattes concolores, les fémurs postérieurs présentant deux larges bandes brunes assez nettes. Pubescence presque nulle sur le dos, qui est luisant, rare sous le corps et sur les pattes.

TÊTE.—Occiput peu bombé, front très court et oblique terminé par un rostre assez court, mais profondément et largement incisé, divisé en deux petits tubercules coniques, indépendants jusqu'à la base; à la face externe de chaque tubercule se trouve une tache ocellaire petite, mais très nette. Face assez étroite, d'un testacé roux uniforme; écusson facial large, présentant une petite impression près de chaque angle du clypéus; son bord supérieur se terminant, entre les antennes, en un tubercule assez large, peu saillant. Clypéus trapézoïdal, à bord supérieur un peu convexe, au moins double de la hauteur, bords latéraux sinués. abre un peu allongé, à bords latéraux convexes. Pubescence très rare sur la face, un peu plus abondante sur les joues, en arrière des yeux.

Yeux noirs, un peu plus longs que le diamètre de la fossette antennaire à laquelle ils sont accolés; bord externe assez fortement convexe, bord interne légèrement concave, angle inférieur arrondi, angle supérieur assez aigu ; surface assez fortement bombée et comprimée en avant.

Antennes rousses, très longues ; article I grand, à bord externe un peu concave, bord interne faiblement renflé près de la base ; article II moins gros que I, mais court et un peu étranglé au milieu, III allongé, cylindrique, IV et suivants assez grêles, cylindriques, un peu plus courts que la moitié de III ; les articles suivants s'allongent insensiblement jusqu'à devenir filiformes, presque impossibles à délimiter. Pubescence très rare, dressée.

Pièces buccales: mandibules fortes, à face externe rousse, bord interne noir, denté. Maxilles à lacinias tridentés à l'apex ; palpes longs et grêles, à articles I et II assez courts, dilatés au sommet, III cylindrique, très allongé, IV très grêle, un peu plus long que III, faiblement dilaté dans le quart apical, V un peu plus court que les deux précédents réunis, très peu dilaté à l'apex ; pubescence fine, peu abondante.

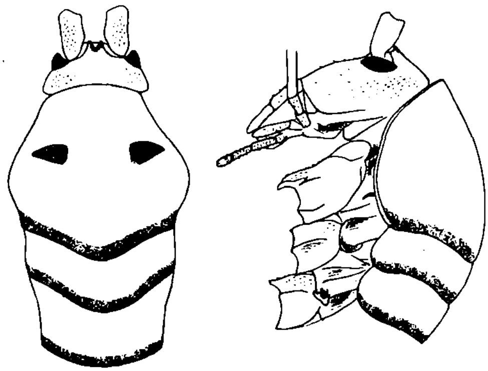

FIG. XV.—*Paradiestrammena annandalei*, Kirby.
Tête et thorax, face dorsale et profil. × 6.

Labium peu allongé, à pièce basilaire aussi longue que large, mentum court ; palpigère sillonné au milieu, à lobes courts, les externe arrondis au sommet ; palpes assez forts, à article I très court, II double de I mais assez épais, III égal à I et II réunis, assez fortement dilaté.

THORAX.—Pronotum assez étroit en avant, mais fortement dilaté un peu en arrière du milieu ; disque fortement bombé, luisant, finement ponctué et présentant de chaque côté une grande impression triangulaire, brune ; bord antérieur à peine convexe ; bord postérieur fortement convexe au milieu, légèrement sinué sur les côtés ; lobes latéraux élevés, à bord inférieur rebordé, faiblement convexe et remontant fortement en avant, l'angle antérieur nul, angle postérieur droit, arrondi. Bord postérieur assez étroitement et nettement bordé de brun.

Mésonotum à bord postérieur fortement convexe au milieu, concave sur les côtés, ses lobes latéraux très élevés à bord inférieur très convexe ; bord postérieur marginé de brun comme au pronotum.

Métanotum à bord postérieur peu convexe, lobes latéraux moins élevés qu'au mésonotum, très largement arrondis.

Pubescence nulle sur le thorax dont le tégument est luisant et très finement ponctué.

Dessous du thorax blanc jaunâtre, à pièces chitinenses assez réduites, pubescence rare et dressée; prosternum très large, à pièce sclérifiée en U à branches divergentes en avant; mésosternum présentant une grande pièce rectangulaire profondément sillonnée transversalement; métasternum assez large, un peu rétréci postérieurement.

Episternes et épimères en bourrelets, séparés par un profond sillon; au prothorax, ils sont très courts, presque entièrement cachés sous le pronotum; au mésothorax les épisternes, assez longs, ont leur bord inférieur lamellaire, fortement arrondi; au métathorax, le bord inférieur de l'épisterne présente une assez forte denticulation bifide. Les stigmates, grands, s'ouvrent en arrière des épimères, dans la membrane d'union avec le somite suivant.

Abdomen.—Abdomen légèrement caréné en dessus vers l'extrémité, les trois premiers tergites glabres et bordés de brun postérieurement; 10^e^ tergite tronqué et légèrement excavé à l'apex, ses bords latéraux très obliques, ses angles un peu arrondis; 11^e^ tergite assez allongé, en forme d'ogive, à apex subaigu, lisse et formant un léger bourrelet saillant; valves anales triangulaires arrondies.

Dessous de l'abdomen jaunâtre, à pubescence rare, dressée; sternites assez petits, s'élargissant progressivement jusqu'au 6^e^, le 1^er^ étant invisible; 7^e^ sternite beaucoup plus grand que les précédents, lisse, à pubescence très rare, légèrement renflé et ondulé au milieu; plaque sous-génitale assez petite, présentant de chaque côté de la base un lobe arrondi assez développé, son bord postérieur étant convexe dans l'ensemble, mais divisé par des incisions peu profondes en 5 lobes dont un médian très petit, deux submédians larges et peu saillants et deux latéraux un peu plus saillants et venant joindre le lobe basal par leur bord externe très allongé.

Cerques un peu plus courts que l'oviscapte, à pubescence fine et peu abondante.

Oviscapte.—Oviscapte assez court, presque droit, dépassant légèrement les cerques. Valves supérieures étroites, un peu dilatées à la base, leur bord supérieur très légèrement concave, leur bord inférieur droit presque jusqu'à l'apex; valves inférieures de même longueur que les supérieures, aiguës à l'apex, à bord inférieur très faiblement convexe dans le tiers apical et armé de 12 denticulations larges et plates. Valves internes étroites et très longues, atteignant presque l'apex de l'oviscapte.

Pattes.—Pattes antérieures; hanches longues, à face externe concave et bord antéro-externe fortement saillant, armé un peu au-dessous du milieu d'une grande épine dirigée vers le bas, extrémité inférieure de ce bord se dilatant en un lobe triangulaire; face interne arrondie, longuement prolongée en un lobe apical aigu, face antérieure divisée par une forte suture oblique. Trochanters courts, un peu dilatés à l'apex. Fémurs assez fortement renflés à la base, roux uniforme, à pubescence peu abondante; apex armé d'une longue épine externe et d'une petite épine interne fixe. Tibias un peu plus longs que les fémurs, légèrement comprimés, velus, armés au bord inférieur externe de deux épines situées, à égale distance des deux extrémités du tibia ; apex portant trois éperons, deux inférieurs longs, sourtout l'externe, et un petit supérieur externe ; entre les deux éperons inférieurs se trouve une très petite épine médiane. Tarses très allongés, comprimés ; métatarses moitié plus longs que les autres articles réunis, 2^e article égalant à peine le quart du métatarse, 3^e article très court, tous trois garnis en dessous de deux rangées de poils spinuliformes ; 4^e article un peu plus long que le 2^e, légèrement dilaté à l'apex ; griffes assez courtes, peu aiguës.

Pattes intermédiaires : hanches inermes, plus courtes que les hanches antérieures, à lobes apicaux peu développés ; trochanters courts. Fémurs et tibias semblables aux antérieurs, les fémurs armés de deux longues épines apicales mobiles ; tibias portant, à la face inférieure, deux épines externes occupant la même situation qu'aux tibias antérieurs, mais plus faibles ; apex armé de 4 éperons dont les deux supérieurs très petits et d'une petite épine apicale, entre les deux éperons inférieurs. Tarses semblables aux tarses antérieurs mais un peu plus courts.

Pattes postérieures : hanches courtes, épaisses, séparées par un intervalle presque égal à leur propre largeur ; trochanters très courts. Fémurs assez fortement renflés à leur base, armés de deux bandes brunes obliques, assez larges ; bord inférieur interne armé d'une seule épine, située à peu près au milieu ; apex armé d'une épine géniculaire interne. Tibias sensiblement plus longs que les fémurs, comprimés, surtout vers la base et armés de 15 à 20 épines assez régulièrement espacées et laissant un espace mutique à la base et entre l'épine apicale et la précédente ; vers le quart apical, une épine sur chaque bord se montre nettement plus forte que les autres et est insérée au dessus d'un petit sillon ; éperon supérieur interne plus court que le métatarse.

DIMENSIONS.—Je n'ai examiné qu'un individu femelle de cette espèce (co-*type* du British Museum) ; ses principales dimensions sont les suivantes :

Long. du corps	.. 15 mm.	Fémur ant. ..	.. 12·5 mm.
„ „ pronot.	.. 6 mm.	Fémur intern.	.. 11·5 mm.
Cerques ..	.. 9·5 mm.	Fémur post...	.. 20·5 mm.
Oviscapte ..	.. 10 mm.	Tibia post. ..	.. 24 mm.

Cette espèce diffère de *P. gravelyi* Chop. par sa coloration plus uniforme, les cerques plus courts que l'oviscapte et la plaque sous-génitale présentant 5 petits lobes apicaux (en plus des deux grands lobes basaux) au lieu de 3. Nous verrons en étudiant l'espèce suivante que ces différences ne sont pas toujours aussi nettes et qu'il semble exister une forme intermédiaire entre les deux espèces. Néanmoins, je considère actuellement que les seuls exemplaires pouvant être rapportés à *P. annandalei* sont les *types* de Kirby si, toutefois, tous les individus sont semblables à celui que Mr. Bruce F. Cummings a eu l'obligeance de me communiquer.

Paradiestrammena gravelyi, Chopard.

Pl. XIV, figs. 59–67.

Diestrammena gravelyi, Chopard 1916, *Bull. Soc. ent. Fr.*, p. 113, 114.
Diestrammena annandalei (*partim*), Griffini 1915, *Atti Soc. it. Sc. nat.* p. 99.
Diestrammena annandalei, Annandale, Brown and Gravely 1913. *Journ. As. Soc. Bengal.* Vol. IX. 10, p. 405. 413.

Lenggong caves, Perak (*B. A. Buxton*, 17-viii-14); 4 ♂.—Batu caves near Kuala Lumpur (*Robinson*, Dec. 1915), nombreux individus.—Batu cave, under stone at entrance to cave (*N. Annandale*, 2-i-16); 1 ♂.

Goah Gloap, Bukit Tapang, Biserat (*N. Annandale*, 4-ii-16); nombreux exemplaires de la forme *nigricauda*.

Minneryia, Ceylon (*B. H. Buxton*); 1 ♂ immature de la forme *ceylonica*.

Taille moyenne, coloration roussâtre assez foncé avec le bord postérieur des tergites thoraciques et des premiers tergites abdominaux étroitement marginé de brun foncé; pronotum et mésonotum présentant une ligne brune médiane, le pronotum marqué, en outre, de deux taches jaunes très nettes, près de la ligne médiane, au bord antérieur. Antennes et pattes concolores, ces dernières peu distinctement annelées de brun. Pubescence rare et dressée, presque nulle sur le dos qui est très luisant sur le thorax et les trois premiers tergites abdominaux.

TÊTE.—Occiput peu bombé; front déclive, très court; rostre frontal brun, court, anguleusement mais peu profondément incisé au sommet, formant deux tubercules coniques, peu aigus, séparés par une large échancrure, sur une lougueur ne dépassant pas le tiers de la longueur totale du rostre; à la base de chaque tubercule, du côté externe, se trouve une tache ocelliforme jaune. Face assez étroite, roussâtre avec une bande brune très large mais peu marquée de chaque côté de la ligne médiane; écusson facial large, bombé dans la partie médiane, formant un tubercule étroit entre les fossettes antennaires; clypéus trapézoïdal, assez élevé, à bord supérieur un peu convexe, bords latéraux rétrécis un peu au dessus du milieu, disque subcaréné transversalement. Labre un peu allongé, à bords latéraux très convexes, apex incisé. Pubescence assez rare et dressée sur le crâne et sur la face qui sont luisants; bords du labre garnis de longs poils.

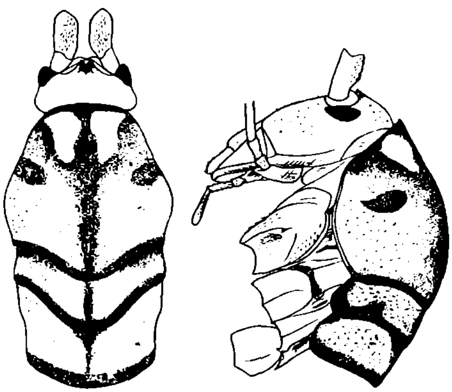

FIG. XVI.—*Paradiestrammena gravelyi*, Chop. Tête et thorax, face dorsale et profil. × 6.

Yeux assez grands, noirs, beaucoup plus longs que larges, subanguleux aux deux extrémités, situés derrière la fossette antennaire et remontant un peu plus haut qu'elle; leur surface est assez faiblement bombée et surtout vers le bord interne, ce qui fait paraître l'oeil un peu conique, vu de dessus.

Antennes rousses, très longue; article I grand, peu rembruni vers l'apex, son bord apical sinué, bord externe faiblement concave, bord interne assez fortement renflé un peu au dessous du milieu; article II court, renflé, III allongé, grêle, un peu dilaté à la base, IV cylindrique, environ trois fois plus long que large, V et suivants cylindriques, un peu plus courts que IV. Pubescence assez abondante sur les deux premiers articles, rare sur les suivants.

Pièces buccales : mandibules noirâtres au bord interne qui est armé d'une double crête dentée, apex armé d'une forte dent recourbée.

Hypopharynx n'atteignant pas l'extrémité du labium, incisé à l'apex.

Maxilles à pièces basilaires anguleuses au bord externe, lacinias grêles, à bord externe peu convexe, bord interne armé de deux dents apicales et d'une anté-apicale très fine, et garni de longs poils raides ; galeas très étroits, arrondis à l'apex. Palpes longs et très grêles, à articles I et II courts, un peu dilatés à l'apex, III cylindrique, grêle, IV un peu plus long que III, très grêle et un peu dilaté dans le quart apical, la partie dilatée rembrunie, V égal à III et IV réunis, un peu incurvé et dilaté à l'apex ; pubescence fine, dressée, peu abondante sauf sur le dernier article.

Labium à pièce basilaire presque carrée, à côtés droits, bord supérieur concave ; mentum rectangulaire, assez allongé, à peine une fois et demie plus large que long ; palpigère allongé, profondément sillonné au milieu ; lobes externes courts, tronqués à l'apex, lobes internes triangulaires, très petits. Palpes assez longs, à article I court et dilaté au sommet, II presque double de I, assez fortement incurvé, III un peu plus long que II, faiblement dilaté. Pubescence dressée, assez longue mais peu abondante sur les pièces du labium, plus serrée sur les lobes externes et les palpes.

THORAX.—Pronotum large, à bord antérieur convexe, très légèrement sinué de chaque côté de la ligne médiane, bord postérieur très fortement convexe au milieu, légèrement concave sur les côtés ; lobes latéraux élevés, à bord inférieur rebordé, oblique antérieurement, un peu convexe dans la moitié postérieure ; angle antérieur très obtus, angle postérieur arrondi ; disque très bombé, luisant mais très finement ponctué, coloration roussâtre assez foncé surtout sur la ligne médiane et aux bords antérieur et postérieur qui sont étroitement mais nettement bordés de brun ; dans la partie antérieure, très près de la ligne médiane, se trouvent deux taches jaunâtres bien nettes ; latéralement on voit deux grandes impressions piriformes, lisses et foncées ; lobes latéraux jaunâtres.

Mésonotum assez fortement convexe au bord postérieur, à lobes latéraux élevés, à bord inférieur très convexe, bord postérieur marginé de brun comme au pronotum, ligne médiane roux foncé.

Métanotum un peu plus long que le mésonotum, bordé de brun postérieurement, bord postérieur faiblement convexe ; lobes latéraux moins élevés qu'au mésonotum à bord inférieur tronqué transversalement.

Pubescence presque nulle sur les tergites thoraciques qui sont très brillants et portent seulement quelques poils dressés surtout sur les bords latéraux.

Dessous du thorax blanchâtre, en grande partie membraneux, à pubescence presque nulle.

Prosternum très large, présentant une grande pièce en U, à branchesdi vergentes, à bord postérieur un peu épaissi en bourrelet et biconvexe ; en avant de cette pièce, de chaque côté du cou se trouve un tubercule assez volumineux, faiblement sclérifié. Episternes et épimères presque entièrement cachés sous le lobe latéral prothoracique ; stigmate grand, placé en arrière de l'épimère.

Mésosternum présentant une grande plaque rectangulaire, courte, à bords relevés et disque profondément sillonné transversalement. Episternes larges, à bord inférieur arrondi et un peu dilaté, épimères très courts, à peine visibles; stigmate assez grand, à péritrème ovale.

Métasternum rétréci en arrière, mais gardant cependant une largeur presque égale à celle des hanches postérieures. Episternes grands, obliques, à bord inférieur faiblement denté; épimères étroits, en bourrelets.

ABDOMEN.—Dessus de l'abdomen roussâtre avec les trois premiers tergites bordés de brun; bord postérieur des tergites III et IV très faiblement concave au milieu; extrémité de l'abdomen faiblement carénée; pubescence dressée, peu abondante. Chez le mâle, le 10e tergite est très largement tronqué à l'apex, à bord postérieur faiblement concave, angles un peu arrondis; 11e tergite assez grand, en forme d'ogive; son apex est assez pointu et présente un bord lisse un peu saillant; valves anales présentant un angle externe saillant, arrondi. Chez la femelle, les tergites sont de forme semblable sauf le 10e qui est moins largement tronqué et à angles plus arrondis; les valves anales sont également moins saillantes à l'angle externe.

Dessous de l'abdomen jaunâtre, à pièces sternales petites et faiblement chitinisées, à pubescence rare et dressée; chez le mâle, les sternites sont à peu près réguliers jusqu'au 9e, s'élargissant progressivement depuis la base; ce dernier est grand, à bord postérieur largement arrondi; il présente latéralement, à sa base, un repli qui se continue sur le disque par un léger renflement transversal. Chez la femelle, les sternites sont petits jusqu'au 6e; le 7e est très grand, légèrement renflé sur le disque, à bord postérieur droit; la plaque sous-génitale est assez petite, large, trilobée, les deux lobes latéraux grands, arrondis, le lobe médian beaucoup plus petit, triangulaire; de chaque côté, à la base, se trouve un petit lobe arrondi à apex denticulé.

Cerques très longs, à pubescence très fine et clairsemée.

ORGANE COPULATEUR DU MÂLE.—Les pièces génitales sont assez saillantes, atteignant l'apex de la plaque sous-génitale; sous les valves anales se trouve un bourrelet transversal, en partie sclérifié, formant le 10e sternite; en dessous est placé l'épiphalle, grand, de forme générale rectangulaire, avec le bord antérieur fortement concave et le bord postérieur présentant un lobule médian saillant, sur lequel est inséré un prolongement aigu, assez développé; sous l'épiphalle se trouve le complexe copulateur comprenant une grande pièce triangulaire supérieure, médiane, et, de chaque côté, une grande valve incurvée portant à sa base un petit prolongement arrondi; entre les deux grandes valves, à leur face inférieure, se trouvent deux petits tubercules médians. Le canal éjaculateur débouche au milieu de ces pièces, un peu en avant des tubercules inférieurs; sa partie terminale présente des replis saillant dans la lumière du canal et couverts de poils très forts et très serrés, dirigés vers l'orifice. Les pièces génitales sont en grande partie couvertes de longs poils; la partie plane de l'épiphalle porte en outre des petits tubercules arrondis, généralement pilifères.

OVISCAPTE.—Oviscapte court, un peu moins long que les cerques, légèrement incurvé vers le haut ; valve supérieure assez étroite, un peu dilatée à la base, à bords presque parallèles jusque près de l'apex qui est très aigu ; bord inférieur un peu convexe, bord supérieur concave et assez brusquement incurvé un peu avant l'apex ; valve inférieure aussi longue que la supérieure, assez aiguë à l'apex, son bord inférieur faiblement convexe, surtout dans la moitié apicale et armé de 14 denticulations larges et plates, à angle inférieur denté. Valve interne étroite, atteignant presque l'extrémité de l'oviscapte, peu aiguë à l'apex.

PATTES.—Pattes antérieures : hanches allongées, à face externe glabre, concave ; bord antéro-externe saillant, armé d'une forte épine brune un peu au dessus du milieu ; face interne velue, à lobe apical très saillant, subaigu au sommet. Trochanters un peu allongés, dilatés à l'apex. Fémurs longs, velus, un peu renflés à la base, ornés de deux anneaux bruns, assez vagues, et rembrunis à l'apex ; face inférieure sillonnée, apex armé d'une longue épine externe mobile et d'une très petite épine interne. Tibias un peu plus longs que les fémurs, grêles, cylindriques, velus et armés en dessous de deux paires d'épines assez longues, les internes un peu plus courtes que les externes et situées un peu au dessus d'elles ; apex présentant deux éperons inférieurs dont l'externe plus long que l'interne et un petit éperon supérieur externe ; entre les éperons inférieurs se trouve une très petite épine médiane. Tarses très grêles, un peu comprimés ; métatarses moitié plus longs que les autres articles réunis, non carénés en dessous et munis sur toute leur longueur d'une double rangée de fines spinules ; 2e article égal au quart du métatarse, également garni en dessous de spinules ; 3e article très court, caréné en dessous, 4e à peine double du 3e, un peu dilaté à l'apex ; griffes fines et aiguës.

Pattes intermédiaires : hanches inermes, à lobe apical interne moins développé qu'aux hanches antérieures. Fémurs et tibias de même forme que les antérieurs ; fémurs armés de deux épines apicales mobiles ; tibias portant, à la face inférieure, deux épines externes situées un peu au dessous du premier et deuxième tiers du tibia et une épine interne placée en face de l'inférieure externe ; apex armé de 4 éperons dont les inférieurs beaucoup plus longs que les supérieurs, et d'une petite épine inférieure médiane. Tarses semblables aux tarses antérieurs.

Pattes postérieures : hanches courtes et épaisses, à face externe aplatie, face interne formant un angle peu saillant ; trochanters courts, cylindriques. Fémurs bien renflés à la base, ornés, à la face externe, de taches brunes irrégulières laissant entre elles deux anneaux clairs au milieu et un peu avant l'apex ; bord inférieur interne armé de trois petites épines, peu distantes entre elles, situées un peu avant le milieu du fémur ; apex présentant une grande épine géniculaire interne. Tibias un peu plus longs que les fémurs, grêles, sillonnés en dessous, ornés de 6 ou 7 anneaux bruns irréguliers ; leurs bords supérieurs sont mutiques sur une assez grande longueur, près de la base, puis armés de 15 à 20 épines assez faibles et assez irrégulièrement espacées ; vers le quart inférieur du tibia, une d'entre elles est plus forte que les autres et séparée des suivantes par un espace mutique ; l'apex porte une épine assez éloignée de la précédente ; éperons grands, velus en dessous, sillonnés en dessus, crochus à l'apex, les internes un peu plus longs que les externes ; inférieurs courts, courbés ;

intermédiaires beaucoup plus longs, droits ; supérieurs doubles des intermédiaires, de même forme qu'eux ; le supérieur interne n'atteint pas l'extrémité du métatarse. Tarses très longs et grêles, un peu comprimés ; métatarses un peu plus longs que les autres articles réunis, armés d'une petite épine apicale ; 2[e] article assez allongé, 3[e] très court, tous deux armés à l'apex de deux très petites épines ; dessous des trois premiers articles non caréné, garni de spinules ; 4[e] article presque aussi long que les 2[e] et 3[e] réunis.

DIMENSIONS.—J'ai mesuré environ une quarantaine d'individus tant de la forme typique que de la forme *nigricauda* ; ils montrent de très faibles variations de taille ; les principales dimensions sont :

Long. du corp ..	14-16·5 mm.	Fém. ant. ..	11·5-13 mm.
„ du pronot. ..	5·5-6 mm.	Fém. interm. ..	10-11·5 mm.
„ de l'oviscapte	8·5-11 mm.	Fém. post. ..	18-23 mm.
„ des cerques ..	9·5-11 mm.	Tibia post. ..	21-24·5 mm.

D'une manière générale, les mâles sont un peu plus petits que le femelles, ne dépassant guère 14 millimètres ; leurs différentes proportions sont d'ailleurs exactement semblables. Les jeunes individus diffèrent fort peu, quant à l'aspect général, des adultes.

Lorsque j'ai décrit cette espèce, je n'avais sous les yeux que quelques mâles de Lenggong caves et une femelle provenant du British Museum, de Selangor. Cette dernière, comparée au co-*type* de *P. annandalei* qui m'avait été communiqué en même temps, montrait des différences très nettes que j'ai résumées dans le tableau placé en tête du genre. Depuis, des matériaux abondants m'ont été procurés par Mr. N. Annandale, provenant à la fois des grottes de Jalor et de celles de Selangor. J'ai pu constater alors que la forme de Jalor, bien que très semblable par sa coloration à la forme typique, se rapproche par bien des caractères de *P. annandalei* et établit ainsi un véritable passage entre les deux espèces. En résumé je suis amené à considèrer qu'il existe à Jalor deux formes de *Paradiestrammena* un peu différentes entre elles et différant également de celle de Selangor.

Enfin il faut noter que B. H. Buxton a trouvé à Ceylan une forme, malheureusement immature, mais évidemment très voisine de *P. gravelyi*, ce qui semble indiquer que cette espèce a une aire de répartition beaucoup plus étendue que les trois espèces voisines. Comme ces dernières, elle semble en outre strictement cavernicole et je n'ai vu jusqu'à présent que des individus provenant des grottes.

Les trois formes de *P. gravelyi* peuvent être caractérisées comme suit :

Forma typica.—Coloration bien marquée, mais pattes faiblement annelées. Rostre frontal peu profondément incisé au sommet. Oviscapte très nettement plus court que les cerques (1, 5 à 2 mm.) ; plaque sous-génitale femelle présentant en outre des deux lobes basaux, trois lobes apicaux dont les deux latéraux très larges, arrondis, et le médian petit, triangulaire, très légèrement incisé à l'apex. Tibias antérieurs portant 4 épines,inférieures disposées par paires ; tibias intermédiaires présentant 2 épines inférieures externes et 1 interne seulement ; fémurs postérieures à bord inférieur interne armé de 2 ou 3 spinules. Hab. Selangor caves.

Forma nigricauda, nova.—Coloration encore plus marquée que dans la forme typique, mais avec les taches claires du pronotum plus foncées et ressortant peu sur la couleur du fond ; pattes indistinctement annelées, rembrunies. Rostre frontal un peu plus profondément, et surtout plus largement, échancré à l'apex. Oviscapte égalant ou même parfois dépassant un peu les cerques ; ceux-ci très foncés, noirâtres ; plaque sous-génitale femelle présentant 3 lobes apicaux subégaux, le médian assez fortement échancré à l'apex. Tibias antérieurs et intermédiaires armés seulement de 2 épines externes très faibles; fémurs postérieurs présentant au bord inférieur interne 1 seule très petite épine, pouvant même manquer. Hab. Jalor caves.

Forma ceylonica.—Coloration bien marqueé, à taches claires du pronotum peu visibles, de même que chez *nigricauda* ; pattes très nettement annelées de brun. Rostre frontal étroit, assez profondément et étroitement échancré à l'apex. Cerques plus courts que chez la forme typique. Fémurs postérieurs armés d'une seule épine sur le bord inférieur interne. Hab. Ceylan.

Ou voit que ces trois formes sont très voisines mais la forme *nigricauda* montre dans l'échancrure du rostre, la longueur comparative des cerques et de l'oviscapte et l'armature des pattes des caractères qui la rapprochent nettement de *P. annandalei.* Il serait donc fort intéressant de retrouver des individus de ce dernier et spécialement des mâles qui permettraient de séparer plus nettement cette espèce des différentes races, de *P. gravelyi* ; les pièces génitales du mâle, et en particulier l'épiphalle, montrent en effet chez ces dernières une conformation des plus constantes.

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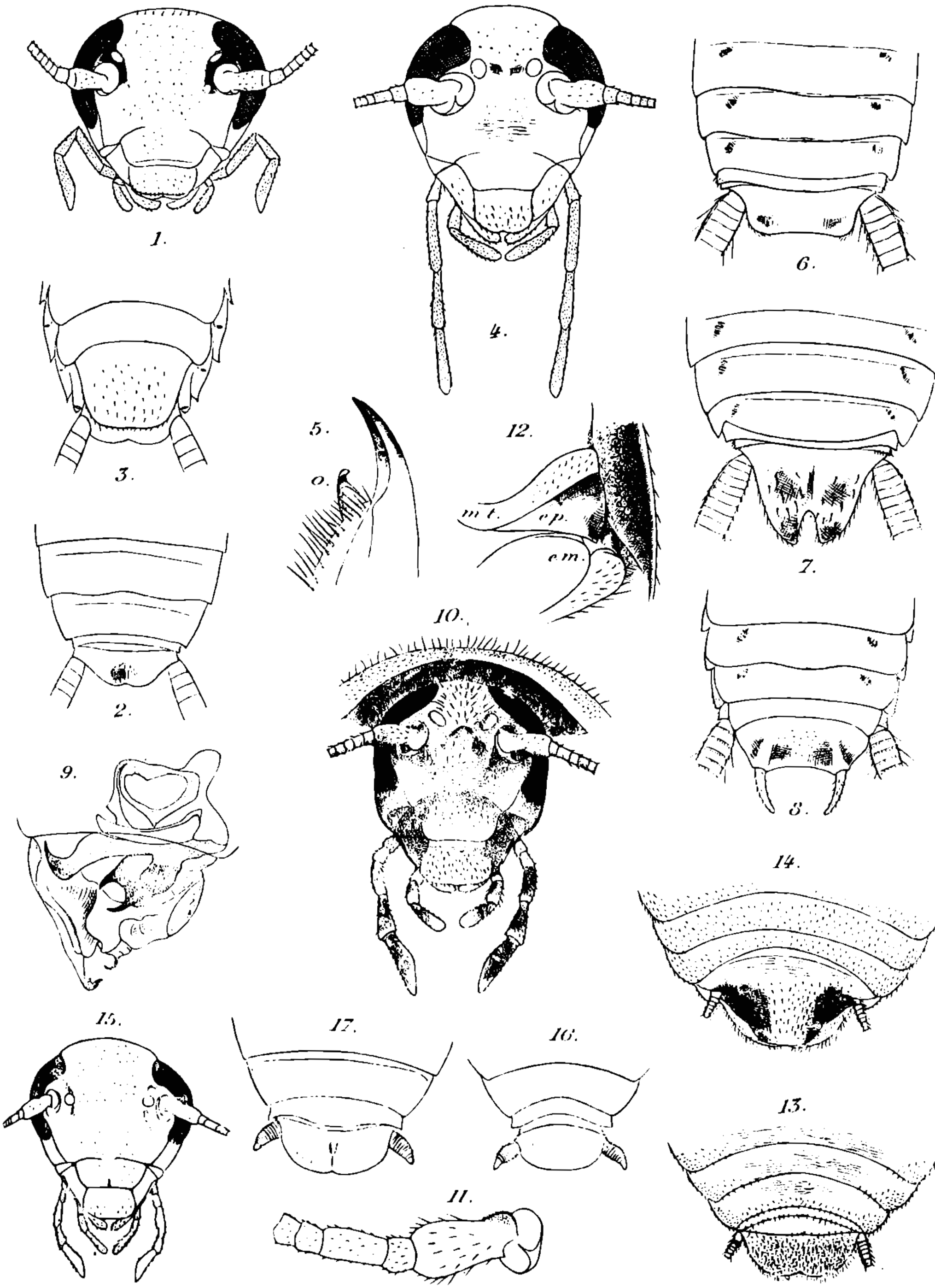
EXPLICATION DE LA PLANCHE XII.

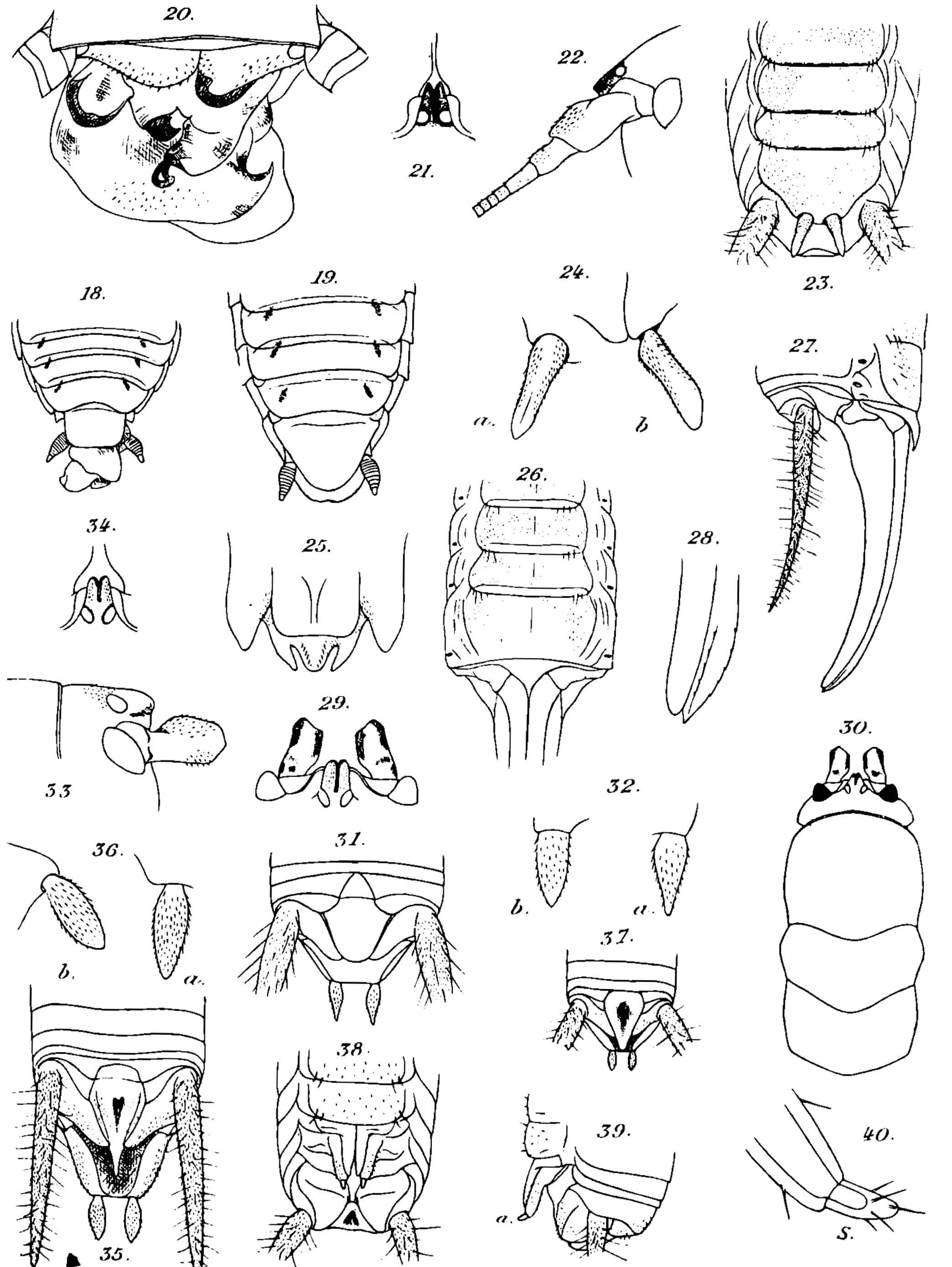
FIG. 1.—*Phyllodromia nigrocincta*, n. sp.—Tête, vue de face, × 14.
FIG. 2.— Do. Extrémité abdominale ♀, face dorsale, × 7.
FIG. 3.— Do. Extrémité abdominale ♀, face ventrale, × 7.
FIG. 4.—*Periplaneta cavernicola*, n. sp.—Tête, vue de face, × 5.
FIG. 5.— Do. Extrémité de la maxille gauche, face inférieure, × 28; *o*, organe de Bugnion.
FIG. 6.— Do. Extrémité abdominale ♂, face dorsale, × 4.
FIG. 7.— Do. Extrémité abdominale ♀, face dorsale, × 4.
FIG. 8.— Do. Extrémité abdominale ♂, face ventrale, × 4.
FIG. 9.— Do. Ensemble des pièces génitales du ♂, vues du dessus, × 7.
FIG. 10.—*Miroblatta silphoides*, n. sp.—Tête, vue de face, × 7.
FIG. 11.— Do. Premiers articles de l'antenne droite, face interne, × 19.
FIG. 12.— Do. Face inférieure de la base de l'élytre gauche, × 4; *mt.*, métasternum; *ep.*, épisterne métathoracique; *em.*, épimère.
FIG. 13.— Do. Extrémité abdominale ♀, face supérieure, × 4.
FIG. 14.— Do. Extrémité abdominale ♀, face inférieure, × 4.
FIG. 15.—*Leucophaea striata* Kirby.—Tête, vue de face, × 7.
FIG. 16.— Do. Extrémité abdominale ♂, face supérieure, × 6.
FIG. 17.— Do. Extrémité abdominale ♀, face supérieure, × 6.



ORTHOPTERES CAVERNICOLES.

EXPLICATION DE LA PLANCHE XIII.

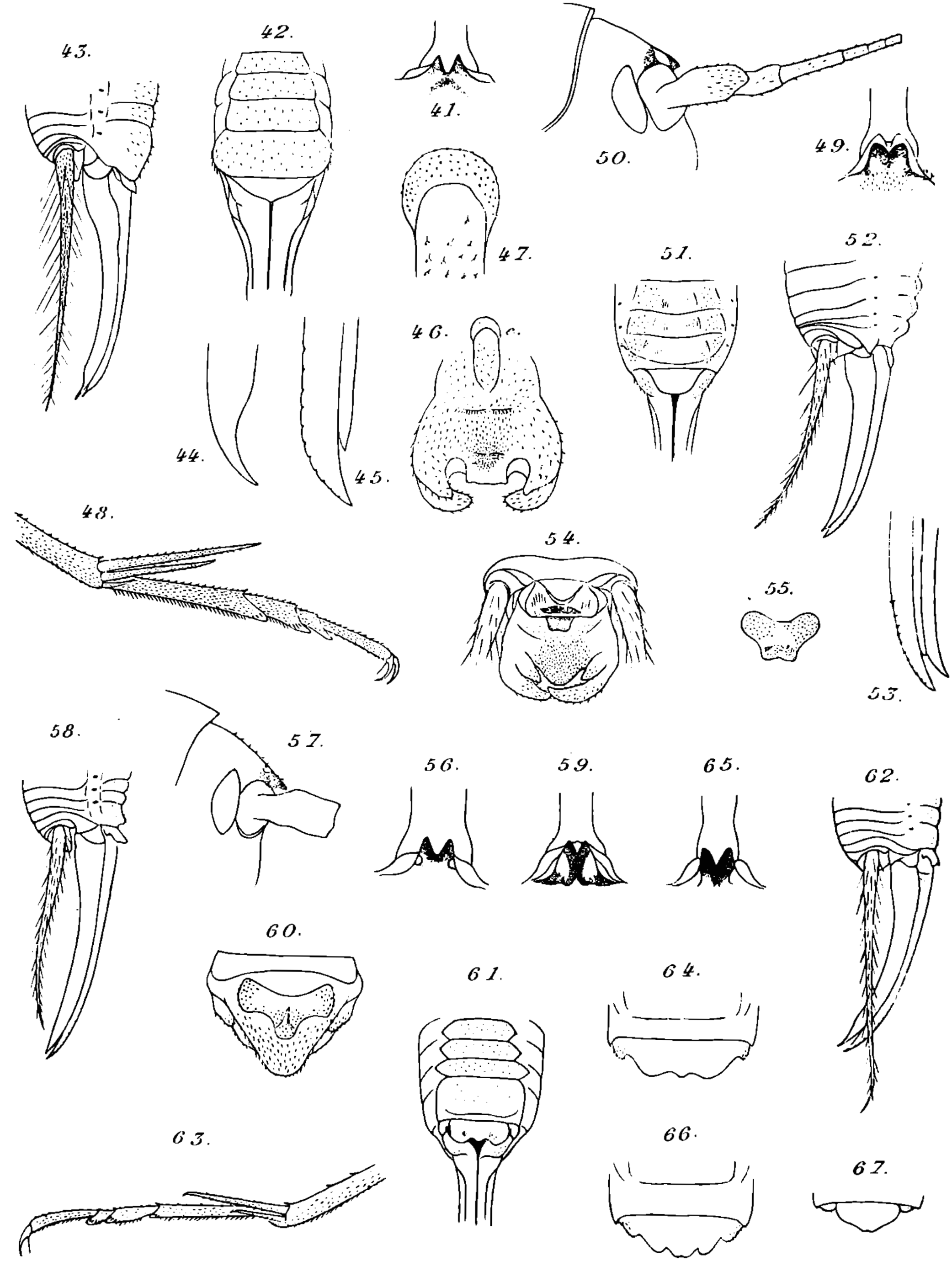
FIG. 18.—*Leucophaea striata* Kirby.—Extrémité abdominale ♂, face inférieure, × 4.
FIG. 19.— Do. Extrémité abdominale ♀, face inférieure, × 4.
FIG. 20.— Do. Ensemble des pièces génitales ♂, vues du dessus, × 19.
FIG. 21.—*Rhaphidophora cavernicola* Chop.—Rostre frontal, vu du dessus, × 7.
FIG. 22.— Do. Rostre frontal et base de l'antenne, vus latéralement, × 7.
FIG. 23.— Do. Extrémité abdominale ♂, face ventrale, × 4.
FIG. 24.— Do. Styles du mâle : *a*, face dorsale ; *b*, face latérale, × 7.
FIG. 25.— Do. Ensemble des pièces génitales ♂, vues du dessus, × 7.
FIG. 26.— Do. Extrémité abdominale ♀, face ventrale, × 4.
FIG. 27.— Do. Extrémité abdominale ♀ et oviscapte, face latérale, × 3.
FIG. 28.— Do. Extrémité des valves de l'oviscapte, face, externe, × 14.
FIG. 29.—*Rhaphidophora mulmeinensis* Chop.—Rostre frontal, dessus, × 10.
FIG. 30.— Do. Tête et thorax, dessus, × 4.
FIG. 31.— Do. Extrémité abdominale ♂, face dorsale, × 4.
FIG. 32.— Do. Styles du mâle : *a*, face dorsale ; *b*, face latérale, × 7.
FIG. 33.—*Rhaphidophora acutelaminata* Chop.—Rostre frontal et base de l'antenne, face latérale, × 10.
FIG. 34.— Do. Rostre frontal, face dorsale, × 10.
FIG. 35.— Do. Extrémité abdominale ♂, face dorsale, × 4.
FIG. 36.— Do. Styles du mâle : *a* face dorsale ; *b*, face latérale, × 7.
FIG. 37.— Do. Extrémité abdominale d'un jeune ♂, de 6 mm. de long, × 6.
FIG. 38.— Do. Extrémité abdominale et oviscapte d'une jeune ♀, de 8 mm. de long, × 7.
FIG. 39.— Do. Face latérale de la même, × 7 ; *a*, style.
FIG. 40.— Do. Extrémité de la valve supérieure de l'oviscapte de la même, × 40 ; *s*, style.



ORTHOPTERES CAVERNICOLES.

EXPLICATION DE LA PLANCHE XIV.

FIG. 41.—*Paradiestrammena feai* Chop.—Rostre frontal, face dorsale × 10.
FIG. 42.— Do. Extrémité abdominale ♀, face ventrale, × 6.
FIG. 43.— Do. Extrémité abdominale ♀ et oviscapte, face latérale, × 5.
FIG. 44.— Do. Extrémité de la valve supérieure de l'oviscapte, × 14.
FIG. 45.— Do. Extrémité des valves inférieure et interne de l'oviscapte, face interne, × 14.
FIG. 46.— Do. Ensemble des pièces génitales du ♂, face dorsale, × 14; *e*, épiphalle.
FIG. 47.— Do. Tête de l'épiphalle, × 42.
FIG. 48.— Do. Extrémité du tibia et tarse postérieurs droits, face interne, × 8.
FIG. 49.—*Paradiestrammena brevifrons* Chop.—Rostre frontal, face dorsale, × 14.
FIG. 50.— Do. Rostre frontal et base de l'antenne, face latérale, × 10.
FIG. 51.— Do. Extrémité abdominale ♀, face ventrale, × 4.
FIG. 52.— Do. Extrémité abdominale ♀ et oviscapte, face latérale. × 4.
FIG. 53.— Do. Extrémité de l'oviscapte, face interne, × 7.
FIG. 54.— Do. Pièces génitales du ♂, face dorsale, × 6.
FIG. 55.— Do. Épiphalle isolé, × 10.
FIG. 56.—*Paradiestrammena annandalei* Kirby.—Rostre frontal, face dorsale, × 14.
FIG. 57.— Do. Rostre frontal et base de l'antenne, face latérale, × 14.
FIG. 58.— Do. Extrémité abdominale ♀ et oviscapte, face latérale, × 4.
FIG. 59.—*Paradiestrammena gravelyi* Chop.—Rostre frontal, face dorsale, × 14.
FIG. 60.— Do. Pièces génitales du ♂, vues du dessus, × 14.
FIG. 61.— Do. Extrémité abdominale ♀, face ventrale, × 4.
FIG. 62.— Do. Extrémité abdominale ♀ et oviscapte, face latérale, × 4.
FIG. 63.— Do. Extrémité du tibia et tarse postérieurs gauches, face interne, × 6.
FIG. 64.— Do. Plaque sous-génitale ♀, × 7.
FIG. 65.—*P. gravelyi* forma *nigricauda* Chop.—Rostre frontal, face dorsale, × 14.
FIG. 66.— Do. Plaque sous-génitale ♀, × 7.
FIG. 67.— Do. Plaque sous-génitale d'une jenne ♀, longue de 13 mm., × 7.



ORTHOPTERES CAVERNICOLES.

MEMOIRS

OF THE

ASIATIC SOCIETY OF BENGAL

VOL. VI, pp. 397—433.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

EDITED BY N. ANNANDALE, D.Sc., F.A.S.B.

PART VII.

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CALCUTTA:

PRINTED AT THE BAPTIST MISSION PRESS, AND PUBLISHED BY
THE ASIATIC SOCIETY, 1, PARK STREET.

1921.

Price Rs. 2; or 3*s*.

24-8-21.

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PART VII.

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Mem. Asiat. Soc. Bengal, Vol. VI.

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By N. ANNANDALE, *D.Sc., F.A.S.B.* (*Zoological Survey of India, Calcutta*).

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In revising the Indian Viviparidae I have had occasion to re-examine the large collection from Japan and China preserved in the Indian Museum, including the specimens collected by myself in 1915. The result has been, so far as the Japanese forms are concerned, to throw light on an interesting species from Lake Biwa which has hitherto been confused with *Vivipara sclateri*, Frauenfeld, but, as a study of the development of the shell demonstrates, is distinct from that species generically.

Vivipara sclateri was described in 1865 by Frauenfeld,[1] who gave a good figure, but no locality more precise than "Japan." Kobelt[2] in his monograph of the land and freshwater molluscs of Japan originated the confusion about the Biwa species, which he figured under the name *Paludina ingallsiana*. All his figures under this name, however, do not represent it, but only fig. 17 on his plate X (young) and fig. 2 on plate XI (adult). The confusion was perpetuated by Iwakawa[3] in his account of the Japanese Viviparidae and Pilsbry[4] did not put the matter straight in his observations on the same subject. Kobelt[5] in his later work in the *Conch. Cab.* left it where it was, and finally in my own account of the molluscs of Lake Biwa[6] I accepted the identifications supplied to me by conchologists, being then interested in the molluscs from a biological rather than a systematic point of view.

The key to the whole confusion is to be found in figs. 13 and 17 of pl. X in Kobelt's paper (1879), which illustrate clearly the differences between the young shell of *V. sclateri* and that of the Biwa species.

With this introduction I may now describe the latter.

Fam. VIVIPARIDAE.

Genus **Heterogen**, nov.

Adult shell fairly thick, of large size, high and narrow, subbiconical, imperforate or rimately perforate, with the aperture rather small and the collumellar callus not

[1] Frauenfeld, *Verh. Zool. bot. Ges. Wien* XV, p. 531, pl. 22 (1865).
[2] Kobelt, *Abh. Sencken. Nat. Ges.* XI (1879).
[3] Iwakawa, *Annot. Zool. Japon.* 1, p. 85 (1897).
[4] Pilsbry, *Proc. Ac. Nat. Sci. Philadelphia* LIV, p. 118 (1902).
[5] Kobelt, *Paludina* in Chemnitz's *Conch. Cab.* (1909).
[6] Annandale, *Mem. As. Soc. Bengal* VI, p. 46 (1916).

expanded or plate-like; the upper part sculptured with more or less obsolescent, thick spiral ridges, the lower part, below the periphery of the body-whorl, nearly smooth.

Embryonic shell of relatively large size, subcylindrical, with the apex minutely blunted, the suture deeply and broadly depressed and each whorl bearing on its

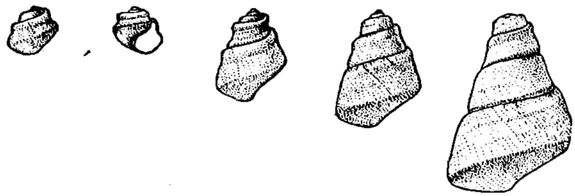

FIG. 1.—Young shells of *Heterogen turris*, sp. nov. (nat. size).

surface two prominent, smooth spiral ridges separated by a broad and deep concave region.

Operculum rather thin, with an unthickened margin and a well-defined funnel-shaped concavity on the external surface, corresponding to a prominent boss on the internal surface surrounded by a thickened muscular scar.

Nothing is known of the anatomy of the animal.

Type-species.—*Heterogen turris*, sp. nov.

Heterogen turris, sp. nov.

The adult shell varies somewhat in outlines and proportions and two types, perhaps sexual, can be distinguished, in one of which (? the female, fig. 2A) the shape is less elongate than in the other (? the male, fig. 2B). In both the upper part of the shell is conical but has the apical whorls invariably eroded. There are

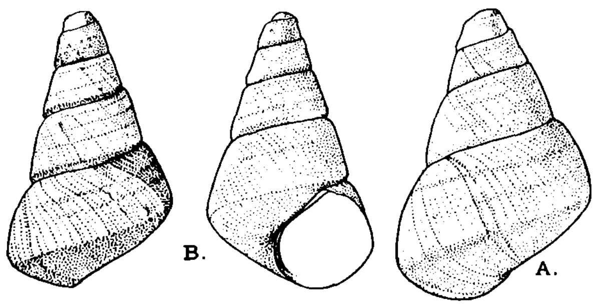

FIG. 2.—Adult shells of *Heterogen turris*, sp. nov. (nat. size).

in all 6½ or 7 whorls, or would be if the shell were complete, but as a rule only the last three remain perfectly intact. These whorls are often almost smooth except for the presence of rather fine but irregular longitudinal striae, but three obscure coarse spiral ridges can usually be distinguished on each. There is a well-defined peripheral carina on the body-whorl and the region below it is entirely without spiral ridges. This region is relatively short and recedes abruptly below the peripheral keel on the body-whorl. The suture in vertical section is distinctly V-shaped. It is moderately oblique. The aperture is subcircular, sometimes subpentagonal owing to the peripheral keel forming a distinct angle on the outer lip and the upper extremity being truncate. The umbilicus is a mere chink or altogether closed. The whole shell is pale olivaceous green more or less densely clouded with black and with a dull polish. The aperture when complete is narrowly edged with black and the interior is bluish white. The eroded apical region is chalky white.

The embryonic shell differs from that of any other Viviparid with which I am acquainted. It is rather broader than high and rather thick. There are $3\frac{1}{2}$ whorls, the apical whorl and a half being very small. The obliquity of the suture increases rapidly so that the outer margin of the penultimate whorl is much deeper than the inner. The spiral ridges on the body-whorl are extremely broad and prominent. The minute sculpture consists of longitudinal striae and very fine transverse striae. The latter are not punctate. The aperture is relatively large and is produced above. The shell is of a very pale olive-green colour with the uppermost half-whorl brownish and the body-whorl sometimes irregularly streaked with black.

Type-series No. 509 and M $\frac{10230}{2}$ Z.S.I. (J. Anderson and N. Annandale *coll.*).

Habitat. The species is apparently peculiar to Lake Biwa. It is a true lacustrine mollusc and occurs from the marginal region to a depth of over 300 feet.

From that of *L. sclateri* (fig. 3), a species found in rice-fields round Lake Biwa, the adult shell is readily distinguished by its texture and sculpture and by the strictly conical outline of the upper region. The young shell is totally different in the two species, that of *L. sclateri* being normal and closely resembling that of other species of the genus *Lecythoconcha*.[1] The embryonic shell of *H. turris* perhaps resembles that of the Chinese genus *Rivularia*, Heude, but I can only judge of this by comparison with adult shells of the latter. It bears a quite superficial resemblance to that of *Margarya* from Western China.

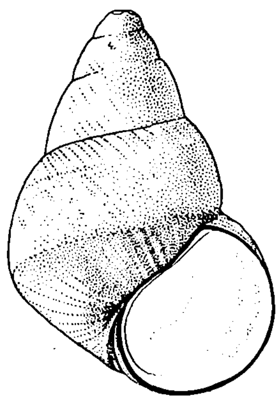

FIG. 3.—Large shell of *Lecythoconcha sclateri* (Fld.) (nat. size), from rice-field near L. Biwa.

The species of Viviparidae found round Lake Biwa in pools of water (*malleata*, Reeve) and in rice-fields (*sclateri*, Frauenfeld and *japonica*, V. Martens), I assign provisionally to my new genus *Lecythoconcha*.

[1] For this group of species I have just proposed this new generic name, largely on anatomical grounds. The description has been published in the *Records of the Indian Museum*, vol. XIX, p. 111 (1920).

Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

MYSIDACEA, TANAIDACEA AND ISOPODA.

By W. M. TATTERSALL, *D.Sc., Keeper of the Manchester Museum.*

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MYSIDACEA, TANAIDACEA AND ISOPODA.

By W. M. TATTERSALL, *D.Sc., Keeper of the Manchester Museum.*

(Pls. XV, XVI, XVII.)

Dr. Annandale has kindly entrusted to me for examination the Crustacea belonging to the three orders Mysidacea, Tanaidacea and Isopoda (marine or aquatic species only) which he procured during his tour in the Eastern parts of Asia. The collection contains sixteen species, seven Mysids, one Tanaid and eight Isopods and has proved of exceptional interest. I am much indebted to Dr. Annandale for the opportunity of examining it.

The collections were made mainly in brackish or freshwater lakes and while the number of species collected is not large, some interesting results were obtained.

In L. Biwa, Dr. Annandale found an *Asellus* which I am unable to distinguish from the cosmopolitan *Asellus aquaticus* of Europe and America. This discovery fills a gap in the known distribution of this species and links up its known occurrence over the greater part of Europe and Northern Asia with the records of the same species from America. It is a survival of the time when Japan was connected by land with the rest of the continent of Asia and with North America by the land bridge to Alaska.

The most interesting specimens in the collection belong to a species of *Caecidothea* found in a well in Otsu. This genus has hitherto only been found in North America. The Japanese species is of further interest in the fact that it possesses distinct eyes and may thus be regarded as a more primitive species than its North American congeners, which are all blind. Otherwise it is a true *Caecidothea*, affording no characteristics to distinguish it generically. The record is a most interesting one from the point of view of geographical distribution.

The remaining species from Japan in the collection were found as follows:—

MARINE SPECIES.

Siriella watasei, Nak.

Gastrosaccus vulgaris, Nak.

Anisomysis ijimai, Nak.

Rhopalophthalmus egregius, Hansen.

BRACKISH WATER.

Neomysis awatschensis, Brandt.

L. Kasumi-ga-ura.

FRESH WATER.

Tachaea chinensis, Thiel.
Ogura Pond, near Kyoto.
Ichthyoxenus japonensis, Richardson.
Lake Biwa.

Among the Mysidacea *Siriella watasei*, *Gastrosaccus vulgaris* and *Anisomysis ijimai* are so far only known from the seas in the neighbourhood of Japan, while *Rhopalophthalmus egregius* has a wide distribution in the tropical and sub-tropical parts of the Indian and Pacific Oceans from India to Japan.

On the other hand the brackish water species, *Neomysis awatschensis*, is an immigrant from the North, known hitherto from Kamtschatka.

The two Isopods, *Tachaea chinensis* and *Ichthyoxenus japonensis*, are representatives of genera widely distributed in fresh and brackish water in India, Indo-Malaysia and the islands of the East Indies.

From China the following species were obtained, all from fresh water :—

TAI-HU.

Tachaea chinensis, Thiel.
Exosphaeroma oregonensis, Dana.

WHANGPOO RIVER, BELOW SHANGHAI.

Neomysis nigra, Nak.
Cleantis annandalei, Tattersall.
Exosphaeroma oregonensis, Dana.
Exosphaeroma chinensis, Tattersall.

Of these species, *Tachaea chinensis* is common to Japan and China and is a representative of a southern and tropical fauna. The other species have probably entered the brackish waters of China from the North and are evidence of a northern element in the fauna. *Neomysis nigra* is known from Japan and is very closely allied to the northern *N. awatschensis*. *E. oregonensis* is known from brackish water in Alaska and from several places along the western shores of N. America to as far South as California. The brackish water species of these groups of Crustacea found in China and Japan appear to suggest therefore at least two distinct sources of origin for that fauna.

The Mysids, *Neomysis awatschensis* and *N. nigra*, are distinctly immigrants from the North and there is no suggestion of a southern element in the Mysidacean fauna of the brackish waters of Japan and China. Both species are of the nature of relict species.

Among the Isopods of the same fauna *Tachaea chinensis* found in both China and Japan is of southern origin, while the two species of *Exosphaeroma* and *Cleantis annandalei* probably entered from the North. The purely freshwater species *Asellus aquaticus* and *Caecidothea kawamurai* are survivors of a fauna of much earlier times, when Japan was in land connection with both America and the rest of Asia.

The collections from the Talé-Sap are small and include the following species :—

MARINE.

Rhopalophthalmus egregius, Hansen.

FRESH TO BRACKISH WATER.

Nanomysis siamensis, gen. and sp. nov.

Apseudes sp.

Ligia exotica Roux.

The Mysid *Nanomysis siamensis* affords the only real evidence of the affinities of the brackish water fauna of this lake.

It is closely related to a species I have described from similar habitats in India (*Potamomysis assimilis*, W.M.T.) and shows no kind of relationship with the species found in China and Japan.

Four species have been described as new to science,

Nanomysis siamensis, gen. et sp. nov.

Caecidothea kawamurai, sp. nov.

Exosphaeroma chinensis, sp. nov.

Cleantis annandalei, sp. nov.

I desire to express my thanks to my wife for the drawings illustrating this paper.

Order MYSIDACEA.

Sub-order MYSIDA.

Family MYSIDAE.

Sub-fam. *SIRIELLINAE.*

Genus **Siriella**, Dana.

Siriella watasei, Nakazawa.

S. watasei, Nakazawa, 1910, p. 256. pl. viii, figs. 8, 36.

Locality :—Tateyama, mouth of Tokyo Bay, Japan, two females (presented by Dr. Nakazawa).

In the absence of males, these specimens agree very closely with the description given by Nakazawa. The species is only known as yet from Japanese waters.

Sub-fam. *GASTROSACCINAE.*

Genus **Gastrosaccus**, Norman.

Gastrosaccus vulgaris, Nakazawa.

G. vulgaris, Nakazawa, 1910, p. 253, pl. viii, figs. 6, 23, 24, 29, 35.

G. vulgaris, Zimmer, 1918, p. 15, text figs. 1-4.

Locality :—Osaka Market, Japan, 24. xi, 15, one male.

Zimmer has completed the description of this species by an account, with figures of the first two and last two pleopods of the male. He notes that, in the female, the first pair of pleopods are only one-branched instead of two-branched as described by Nakazawa. The species is known, so far, only from Japan and Formosa.

"Among large quantities of *Acetes japonicus*, Kish., on sale in the market, probably from the mouth of the Yeddo River. *N. A.*"

Sub-fam *RHOPALOPHTHALMINAE.*

Genus **Rhopalophthalmus**, Illig, 1906.

Rhopalophthalmus egregius. Hansen.

R. egregius. Hansen, 1910, p. 49, pl. vi, figs. 3a-k, pl. vii, figs. 1a-d.
R. egregius, Nakazawa, 1910, p. 255, pl. viii, figs. 12, 22.
R. egregius, Tattersall, 1915, p. 151.
R. egregius, Colosi, 1918, p. 6,

Locality:—Coast of Ariak Sea, Japan, several fathoms, twenty specimens of both sexes (presented by Dr. Nakazawa).

Across the channel from Singgora, Talé Sap, Siam, 4½ metres, 24. i. 1916, two males, 10 mm.

This species is evidently widely distributed in the temperate and tropical parts of the Pacific Ocean and is now known from off Java (Hansen), Japan (Nakazawa), Chilka Lake, Orissa (Tattersall), Torres Straits and Pacific Ocean between New Caledonia and New Zealand (Colosi) and Siam.

Sub-fam. *MYSINAE.*

Nanomysis, gen. nov.

First, second and fifth pleopods of the male, rudimentary, one-jointed and of the same form as the female. Third pleopod of the male with a single-jointed inner ramus and a three-jointed outer ramus which is nearly three-times as long as the inner ramus, the two terminal joints small, the first joint with three long setae on the distal end of the outer margin, the second joint with a single seta on the outer distal corner, the third joint with a single terminal seta longer than the joint.

Fourth pleopod of the male very long, extending to the end of the telson, inner ramus single-jointed, outer ramus four-jointed, the first joint half as long as the whole ramus and almost twice as long as the inner ramus, second joint slightly longer than the third, the terminal joint small and bearing two spiniform setae about four times as long as the joint, third joint with a single long and powerful seta on its outer distal corner twice as long as the third joint and reaching beyond the terminal setae.

Antennal scale narrowly lanceolate and two-jointed, setose all round. Masticatory lobes on the second, third and fourth joints of the endopod of the first thoracic limb well developed.

Tarsus of the posterior thoracic limbs four-jointed.

Inner uropod without spines on the inner margin.

Telson short, apex convex, not split, armed with a comb of spines between two stronger lateral spines, margins with spines along their entire length.

With the aid of Zimmer's key (1915) to the genera of the tribe *Mysini*, it is found that this genus falls into group II D and has its nearest ally in the arctic genus *Stilomysis*. It is to be distinguished from this genus mainly by the much different form of the telson, the absence of a row of spines on the inner margin of the uropods, the presence of lobes on the internal margin of the third and fourth joints of the endopods of the first thoracic limbs and by its very much smaller size.

Superficially and especially in the females, it resembles the genus *Potamomysis*, as recently redefined by me, and can only be distinguished by a close examination of the shape of the telson. But whereas in *Nanomysis*, the third pleopod of the male has a well developed outer ramus, in *Potamomysis* it is a single-jointed plate as in the female.

Nanomysis siamensis, sp. nov.

(Pl. XV, figs. 7-10.)

Locality:—All the specimens in the collection were captured in the Talé Sap, Siam, in January, 1916, at the following stations:—

St. 5. $\frac{1}{2}$ mi. E.N.E. of the mouth of the Patalung River, 2 metres, 13. i. 16, many, fragmentary. $\frac{9327}{10}$. (Fresh water.)

St. 8. $\frac{1}{2}$ mi. off shore a little south of the mouth of the Patalung River, $2\frac{1}{2}$ metres, 14. i. 16, about fifty specimens. $\frac{9328}{10}$, $\frac{9388}{10}$. (Fresh water.) TYPES.

St. 10. Koh Si Hah, 17. i. 16, eight specimens. $\frac{9329}{10}$. (Fresh water.)

St. 25. Narrow channel opposite Ban Lem Chak, near Singgora, $6\frac{1}{2}$ metres, 25. i. 16, one female, 4 mm., $\frac{9326}{10}$. (Sp. grav. 1·00425.)

Description:—Carapace produced in front only slightly in the form of a rostral projection with a pointed apex; the external portion of the frontal margin of the carapace on each side behind the eyes armed with a series of small spinules, those on the extreme outside the largest, the series gradually decreasing in size towards the centre; pleon with the first and fourth segments shortest and equal in size, second and third slightly longer and equal, fifth segment slightly longer than the fourth, sixth segment $1\frac{1}{4}$ times as long as the fifth, telson (Pl. XV, fig. 8) only $\frac{3}{4}$ of the length of the last segment of the pleon, about as long as broad at the base, not cleft, lateral margins armed along their entire length with about 10 small spines with an additional larger spine at the outside corners of the apex, latter slightly convex, half as broad as the base of the telson, and armed with a comb of twelve spines between the larger spines at each corner; inner uropod two and a half times as long as the telson, without spines on its lower inner margin; outer uropod only slightly longer than the inner, about $\frac{1}{10}$ longer.

Second joint of the antennular peduncle very short, first and third joints about equal in size, male appendage well developed and densely hirsute, inner flagellum not much more than one-third, certainly less than one-half of the length of the outer one and much more slender.

Antennal scale (Pl. XV, fig. 7) narrowly lanceolate in shape, about seven times as long as broad, two-jointed, distal joint one-seventh of the entire length of the scale, margin of the scale setose all round; the scale extends for $\frac{3}{5}$ of its length beyond its own peduncle and one-third of its length beyond the antennular peduncle; the second joint of the antennular peduncle is longer than the third and there is a prominent spine on the outer corner of the basal joint from which the scale springs.

Labrum without a spine; masticatory lobes well developed on the second, third and fourth joints of the endopods of the first thoracic limbs; tarsus of the third to the eighth thoracic limbs four-jointed.

First, second and fifth pleopods of the male, as in the female, consisting of a single-jointed uniramous plate.

Third pleopod of the male, (Pl. XV, fig. 9) biramous, inner ramus a single-jointed plate, outer ramus nearly three times as long as the inner ramus, three-jointed, first joint twice as long as the inner ramus, with three long setae on the outer margin near the distal end, second and third joints together about one-third of the first joint the second joint slightly the longer and having a single seta on its outer distal corner, third joint terminated by a single long seta, longer than the third joint but shorter than the second and third joints combined.

Fourth pleopod of the male (Pl. XV, fig. 10) very long, reaching to the posterior end of the telson, biramous, inner branch a single-jointed plate, outer branch four times as long as the inner, four-jointed, the first joint twice as long as the inner ramus, the second joint about half as long as the first, third joint slightly shorter than the second with a single very strong plumose spine on the outer corner, which is nearly twice as long as the joint and extends well beyond the spines on the terminal joint, latter quite short and terminated by two long spines four times as long as the joint.

Length of adult male, 5 mm.

This interesting little species is apparently very abundant in the Talé Sap, more abundant in the inner lake than in the outer. In the inner lake the water is quite fresh, whereas in the outer lake the corrected specific gravity of the water at the time these specimens were taken was 1·00425.

The species is therefore a true lacustrine form. It is readily distinguishable by the spinules on the carapace, the form of the telson and the character of the male pleopods. It is very closely allied to the Indian *Potamomysis assimilis* which lives in very similar habitats, but differs in the form of the telson, and particularly in having the third pleopod of the male rudimentary and of the same form as in the female.

Genus **Neomysis**, Czerniavsky.

Neomysis nigra, Nakazawa.

(Pl. XV, figs. 5-6.)

N. nigra, Nakazawa, 1910, p. 248, pl. viii, figs. 3, 17, 30.

Locality:—Whangpoo River, 5-10 miles below Shanghai, $5\frac{1}{2}$-$7\frac{1}{2}$ metres, 10. xii. 15, nine specimens up to 10 mm. A note on the label reads "Water fresh permanently, but affected strongly by tide. Very muddy. Bottom firm sandy mud" and a further label says that this species was "only caught at or near the bottom."

It is with some doubt that I refer these specimens to *Neomysis nigra*, Nak. Though the specimens measure up to 10 mm. in length, the males are still immature, to judge by the condition of the fourth pair of pleopods. Nakazawa's specimens, though measuring only 7-8 mm, were, from his description, fully mature. But otherwise I have failed to find any noteworthy point of difference and I tentatively refer them to this species until more material is available.

I may perhaps be allowed to supplement Nakazawa's description in a few particulars.

The segments of the pleon diminish successively in size from the first to the fifth, and the sixth segment is one and a half times as long as the fifth.

The telson (Pl. XV, fig. 6) is slightly longer than the last segment of the pleon. It is one and a half times as long as broad at its base. The apex is truncate, one quarter as broad as the base of the telson, and bears two pairs of spines, an inner shorter pair and an outer longer pair, which are about as long as the apex of the telson is wide. The lateral margins bear 18-19 spines extending the whole way down their length.

The inner uropod is about one and a half times and the outer uropod nearly twice as long as the telson.

I have given a figure of the telson and the eye of one of my specimens for comparison with the same parts of *N. awatschensis*, Brandt, a very closely allied species, also occurring in this collection. The two species differ in the following points:—

(1) In *N. nigra* the rostrum is broadly triangular with a pointed apex. In *N. awatschensis* the rostrum is a broadly rounded plate.

(2) *N. nigra* appears to have a broader and stouter eye than in *N. awatschensis*. In *N. nigra* the eye is slightly less than one and a half times as long as broad, with the peduncle half as wide as the eye is long and the pigment occupying the distal half of the eye (Pl. XV, fig. 5). In *N. awatschensis*, the eye is rather more than one and a half times as long as broad, the peduncle only $\frac{1}{3}$ as wide as the eye is long and the pigment occupying less than half of the eye, (Pl. XV, fig. 2).

(3) In the form of the fourth pleopod of the male.

In my most mature male, the fourth pleopod does not extend the whole length of the last segment of the pleon and has the first joint of the outer branch only one and a half times as long as the second, while the terminal setae are only two-thirds the length of the last joint.

Nakazawa says that the outer branch of the fourth pleopod of the male reaches to the middle of the telson, that its proximal joint is four times as long as the distal and that the terminal filaments are longer than the distal joint.

In *N. awatschensis*, the fourth pleopod of the male reaches to the middle of the telson, the proximal joint of the outer branch is double the length of the distal and the terminal setae are rather more than half as long as the distal joint (Pl. XV, fig. 4).

This species is also very closely allied to *N. intermedia*, Czern., but differs in the form of the rostrum and, to judge from Czerniavsky's figures, also in the form of the fourth pleopod of the male.

N. nigra was found by Nakazawa in the Lake of Hamana, a brackish inlet of the sea, and also in the Gulf of Tokio, both localities in Japan. Its occurrence in practically a similar habitat in China is interesting.

Neomysis awatschensis, Brandt.

(Pl. XV, figs. 1-4.)

Mysis awatschensis, Brandt, 1851, p. 126.
Mysis awatschensis, Czerniavsky, 1882, p. 22, pl. xviii, figs. 13-17.
N. awatschensis, Zimmer, 1904.
N. awatschensis, Derzhavin, 1913, p. 197.

Locality:—Lake Kasumi-ga-ura, Japan, 15. x. 15, near bottom, about 30 ft., abundant, up to 10 mm.

This species does not appear to have been redescribed since Brandt published his short account of the species in 1851, except for Czerniavsky's brief diagnosis drawn up from specimens in the Petrograd Museum. This description is based on female examples and it is necessary to supplement it by an account of the pleopods of the male.

The rostrum is in the form of a broadly and evenly rounded plate, not pointed at the apex.

The first five segments of the pleon are more or less subequal while the sixth segment is one and a half times as long as the fifth. The telson (Pl. XV, fig. 3) is as long as the sixth segment of the pleon, one and three quarter times as long as broad at its base, apex truncate, one quarter of the breadth of the telson at its base. The lateral margins of the telson bear about fifteen spines ranged along the whole of their length and the apex bears two pairs of spines, an inner shorter pair and an outer longer pair.

The inner uropod is one and a half times as long as the telson and the outer uropod twice that length.

The eye (Pl. XV, fig. 2) is slightly more than one and a half times as long as broad, the peduncle two-fifths as wide as the length of the eye and the pigmented portion occupying less than one-half of the eye.

There is a prominent spine on the labrum.

The peduncle of the antennules is about one-half of the length of the antennal scale. The latter projects for two-thirds of its length beyond the antennal peduncle and has two prominent spines on the basal joint from which it springs, one on the outer distal corner and the other on the inner lower corner. The scale (Pl. XV, fig. 1) is about eleven times as long as broad, the terminal joint one-fifth of the total length and acutely pointed.

The tarsus of the third to the fifth thoracic limbs is seven-jointed, of the sixth and seventh limbs six-jointed and of the last thoracic limb eight-jointed. The flagellum of the exopod is nine-jointed and the basal joint of the latter has a small spine on its outer distal corner. The lobes on the inner margin of the third and fourth joints of the endopod of the first thoracic limbs are well developed.

The fourth pleopod of the male (Pl. XV, fig. 4) is very long, reaching to the middle of the telson. The proximal joint of the outer ramus is twice as long as the distal joint which in its turn is one and a half times as long as the two terminal setiform processes.

I have already alluded to the close relationship of this species to *N. nigra* and pointed out that it may be distinguished by the characters of the rostrum, eye and fourth pleopod of the male.

It is, however, even more closely allied to *Heteromysis intermedia*, Czerniavsky, which is a true *Neomysis*, and Zimmer has suggested that the two species are probably synonymous. A fuller description of *N. intermedia* is badly needed. Nakazawa has recorded the latter from Japan but has not offered any detailed description of his specimens. The only serious point in which it differs from *N. awatschensis* is in the form of the fourth pleopod of the male. Czerniavsky describes this appendage as having four joints in the exopod, the first and second of which are equal in length and each as long as the inner ramus, the third and fourth joints quite minute and sub-equal, and the two terminal setae short but longer than the combined third and fourth joints. His figure bears out this description, but I am bound to confess that the figure depicts an appendage which does not look to be fully formed and which belongs in reality to an immature male. Until this point is cleared up by an examination of fully adult specimens it is impossible to regard the two species as synonymous.

N. awatschensis is recorded from Kamtschatka by Brandt, Czerniavsky and Derzhavin. The latter author records it as abundant in the brackish water of the rivers of the Kamtschatka peninsula which drain the large series of relict lakes found there. Its habitat in Japan is of precisely the same nature.

"There is an important fishery for these little Mysids in Kasumi-ga-ura, a lagoon of almost fresh water on the Pacific Coast of the Main Island of Japan. They are caught in a peculiar kind of large trawl, the bag of which is formed of very coarsely woven stuff. *N. A.*"

Genus **Anisomysis**, Hansen, 1910.

Anisomysis ijimai, Nakazawa.

A. ijimai, Nakazawa, 1910, p. 252, pl. viii, figs. 5, 14, 27, 33.
A. ijimai, Zimmer, 1915, p. 171.

Locality:—Tateyama, mouth of Tokyo Bay, Japan, numerous specimens (presented by Dr. Nakazawa).

Zimmer has rightly referred *Cryptomysis lamellicauda*, Hansen, to the genus *Anisomysis* and called attention to its very close resemblance to the present species. The only striking point of difference is in the number of curious processes on the inner margin of the second joint of the mandibular palp, 7-8 in *A. ijimai* and 13 in the only known specimens of *A. lamellicauda*. At first I was inclined to consider these species as synonymous but I think perhaps it would be well to await the the examination of further specimens from the type locality of *A. lamellicauda*, especially of male specimens, before deciding this point.

Zimmer, whose recent work on the Mysidacea, has added very largely to our knowledge of the group and whose attempt to systematise the species of the tribe Mysini is of the greatest value, refers both the genera *Cryptomysis*, Hansen, and *Kreagromysis*, Illig, to the synonymy of *Anisomysis*, and the latter genus, therefore, now includes the following species :—

A. laticauda, Hansen ;
A. ijimai, Nakazawa ;
A. lamellicauda, Hansen ;
A. mixta, Nakazawa ;
A. bifurcata, Tattersall (=*Kreagromysis megalops*, Illig) ;
A. australis, Zimmer.

These species agree fundamentally with one another in the form and characters of the pleopods of the male (the male of *A. lamellicauda* is unknown, but in view of the very close affinity of this species with *A. ijimai* there can be little doubt that it also has male pleopods like the other species). In view of this fundamental agreement among this group of species, Zimmer naturally raises the question of the value of the form of the telson as a character of generic importance. In the group generally, the form of the telson has been very largely used as a generic character in the past, and in the main, rightly so. But, for the present, it looks very much as if *Anisomysis* was a genus characterised by great variability in the shape of the telson, with a greater degree of constancy in the other characters. As Zimmer points out, if the shape of the telson is a character of generic importance, the above six species will fall into four genera, viz.:—

ANISOMYSIS	*A. laticauda.*
CRYPTOMYSIS	*A. ijimai, A. lamellicauda.*
KREAGROMYSIS	*A. bifurcata.*
A new genus	*A. mixta, A. australis.*

Future research may demonstrate the existence of groups of species which fall naturally into these genera and justify their separation, but in the present extent of our knowledge Zimmer's arrangement is the more acceptable.

Order **TANAIDACEA.**

Fam APSEUDIDAE.

Genus **Apseudes**, Leach.

Apseudes sp.

Locality:—½ mi. off shore a little south of the mouth of the Patalung River, 2 metres, Talé Sap, 14. i. 16, one specimen.

This specimen belongs almost certainly to a new species but, in the imperfect state of the specimen owing to the breaking off of the uropods, it is inadvisable to give it a name.

It belongs to that group of the genus, of which *Apseudes talpa* Mont., is the type, which is characterised by the presence of eyes, the absence of a spiniform rostral projection and the presence of a prominent spine on the labrum.

In the present specimen, the rostral plate is in the form of a low triangle with an obtusely rounded apex, the height of the triangle less than one-third of the basal distance between the eye lobes. The latter are well developed and the visual elements consist of five scattered groups of about six or seven ocelli each, with intervals between them devoid of ocelli or pigment.

There are no ventral spines on the body nor any prominent spine on the antero-lateral corners of the first free thoracic segment.

The outstanding feature of the specimen is the slenderness of the chelate leg. The carpus is about four times as long as broad, longer than the propodus, of approximately equal width throughout and without any prominent spines. The hand is long and slender and not swollen, while the finger is about one-half the length of the hand. The limb has no distinctive armature.

The third thoracic limb has one stout spine on the merus, two on the carpus and two on the propodus, hidden among the longer setae arming these limbs. The specimen measures 4 mm. in total length.

From information sent with the collection, this specimen was collected in absolutely fresh water in the inner lake of the Talé Sap. I do not know of any previous record of this essentially marine genus from practically fresh water.

" The water at the point at which this specimen was obtained is, almost certainly, always quite fresh, though it is affected to a slight extent by the tides, at any rate at times. *N. A.*"

Order **ISOPODA.**

Sub-order *ASELLOTA*.

Fam. ASELLIDAE.

Genus **Asellus**, St. Hilaire.

Asellus aquaticus (Linn.).

A. aquaticus, G. O. Sars, 1897, p. 97, pl. XXXIX.
A. aquaticus, Racovitza, 1919, p. 37. text figs. 1-6.
Asellus. sp., Hilgendorf, 1874, p. 39.

A. hilgendorfii, Bovallius, 1886, p. 13.
A. hilgendorfii, Hilgendorf, 1893, p. 1.

Locality:—Stations 5,6,8,10,14 and 22, Lake Biwa, Japan, abundant, length up to 10 mm.

It was a matter of great interest to discover this cosmopolitan species in the collections from Japan. After careful examination, I can find no vital points of difference between these specimens and those I have examined from this country. The Japanese form is perhaps somewhat smaller and slightly narrower and there are fewer setae on the second pleopod of the male, but these differences are very slight.

In 1874, Hilgendorf recorded a species of *Asellus* from Japan in the following words "In Graben der Stadt Yedo ist von mir eine Süsswasser-Assel aufgefunden worden. Die fragliche *Asellus*-Art is von der Europaeischen (dem *A. aquaticus*) in mehrfacher Beziehung verschieden: der Lieb ist schmaler, das vierte Beinpaar stark verkurzt und am letzten Segment iste die Spitze einfach gerundet (in der Mitte nicht eingekerbt). Ein Vergleich mit den Nordamerikanischen Arten ist mir nicht möglich."

On the strength of this, Bovallius in 1886 named the species found by Hilgendorf as *A. hilgendorfii* without having seen specimens and merely quoting the above passage from Hilgendorf as a diagnosis of the species.

In 1893, Hilgendorf published a few notes on this species. He says that his previously published remarks were written after a comparison of his Japanese specimens with the description and figures given by Bate and Westwood.

On comparing his Japanese specimens with actual specimens of *A. aquaticus* from Europe he found that the differences in the shape of the posterior end of the metasome and in the comparative lengths of the fourth and fifth thoracic limbs, which he had noted as characterising the Japanese form, did not in reality exist. He does note, however, that in *A. aquaticus* from Europe the fifth thoracic limbs are only 1/8 shorter than the fourth, while in the Japanese specimens, the fifth thoracic limbs are from 1/4-1/3 shorter than the fourth. He notes as further differences that (1) *A. hilgendorfii* is a more slender form than *A. aquaticus*, 3 1/3 times longer than broad as against 2 1/2 times in *A. aquaticus*, (2) the second antenna is only 3/5 of the total length of the body as against 4/5 in the European form and (3) that the uropods in *A. hilgendorfii* have a shorter and broader basal joint and shorter branches. He goes on to remark that in the number of ocelli of the eyes, and, what is of great importance, in the form of the pleopods of the male, the Japanese species agrees absolutely with the European one.

With regard to the differences named by Hilgendorf I find (1) the European species is about three times as long as broad, certainly over 2 3/4, (2) that there is no appreciable difference in the length of the antenna in Japanese and European specimens, (3) that the character of the uropods is not a safe one to rely on, as these appendages are constantly found in a regenerated form after having been broken off, (4) that the difference in the length of the fourth and fifth thoracic limbs in two measured specimens, one of a Japanese specimen and the other of a British are as follows:—in the Japanese specimen the fifth thoracic limb was ·8 of the length of the fourth and in the British specimen ·85.

These differences, therefore, are seen to be very slight and of little importance, and in view of Hilgendorf's positive statement that the pleopods of the male agree perfectly with those of European specimens, may be ignored. I think, therefore, that there is very little doubt that *A. hilgendorfii* should be relegated to the synonymy of *A. aquaticus*. This widely distributed species is now known to occur all over the Palaearctic regions of Europe and Asia and is also found in N. America.

"In Lake Biwa this species was taken in depths of from 180 to 260 feet and appeared to belong to the deep-water fauna, with the molluscs *Pisidium casertanum* (Poli), *Valvata biwaënsis* and *V. annandalei*, Preston, the leech *Ancyrobdella biwae* Oka and the Planarian *Bdellocephala annandalei*, Ijima and Kaburaki, with which it was taken in great abundance. Curiously enough, however, it was also taken in artificial concrete breeding tanks for fish at Hikone near the east side of the lake and, in very large numbers, in an ornamental stone basin containing only a few cubic feet of water and dead leaves in a temple-grove at the same place. *N. A.*"

Genus **Caecidothea**, Packard.

Caecidothea kawamurai, sp. nov.

(Pl. XV, figs. 11-18.)

Locality:—From a well inside a house in the city of Otsu, Japan, 8. i. 1915, collected by Dr. T. Kawamura, three specimens, two males 16-17 mm., one female 11 mm. The well was a shallow one in which light penetrated to the bottom.

Description:—Body (Pl. XV, fig. 11) narrowly elongate in shape, seven times as long as broad, of even width throughout.

Head nearly twice as broad as long, frontal margin slightly concave.

Eyes present as a group of three ocelli on each side of the head, about the centre of the lateral margins.

Thoracic segments more or less subequal in size, and quadrangular in shape; each segment has an impressed line running across the segment at the anterior end; in addition the first segment shows a V-shaped impressed line or groove; lateral parts of the thoracic segments with a few short and scattered setae.

Pleon about one quarter of the whole length of the body, one and three quarter times as long as broad, posterior margin slightly produced into an obtuse lobe between the bases of the uropods.

First antennae short, not extending beyond the distal end of the fourth joint of the peduncle of the second antennae, peduncle equal in length to the first three joints of the peduncle of the second antennae, third joint the longest and narrower than the first two, flagellum composed of thirteen joints.

Second antennae more than half as long as the body, first three joints of the peduncle short, fifth joint one and a half times as long as the fourth and somewhat narrower, flagellum composed of nearly one hundred joints.

The mouth parts present no special points of distinction. They agree essentially with those of *C. stygia*, as figured by Packard.

I give herewith figures of the maxillipede, second, third and eighth thoracic limbs (Pl. XV, figs. 12-15) of the male, which will serve to denote the details of these appendages. The second thoracic limbs are prehensile with the propodal joint dilated and armed with two spines on the proximal part of the palmar margin. They differ from those of *C. stygia*, in having the propodus less dilated and without triangular processes. In this character they approach *C. richardsonae*, Hay, and *C. smithsii*, Ulrich. There is very little difference between the sexes in the form of the second pair of thoracic limbs, those in the female being of essentially the same form as those in the male but slightly smaller.

The first pleopod of the male (Pl. XV, fig. 16) has the sympod armed with four coupling hooks. The ramus consists of a broadly oval plate, twice as long as broad and furnished with setae on the outer and posterior margins, the inner margin being unarmed.

The second pleopod of the male (Pl. XV, fig. 17) differs from the same appendage in *C. stygia* in having a long curved process from the basal joint of the endopod which turns inward along the inner margin of the sympod. The whole appendage is, in fact, curiously like the same appendage in *Asellus aquaticus*.

The third pair of pleopods of the male (Pl. XV, fig. 18) consist of a short sympod, an oval uni-jointed endopod and a very large two-jointed exopod having the posterior margin truncate and armed with a few plumose setae.

The fourth and fifth pairs of pleopods of the male consist of a short sympod and two rami, the endopod unjointed, the exopod slightly larger than the endopod and two-jointed.

The uropods in the male are longer than the pleon, basal joint long and narrow equal to half the length of the appendages, endopod equal in length to the basal joint but narrower and terminated by a tuft of setae, exopod about half the length of the endopod and still narrower, also terminated by a tuft of setae.

In the female the uropods are slightly shorter than the pleon and the exopod is about two-thirds of the length of the endopod. I am unable to say whether this apparent sexual difference is constant, because there is only one female in the collection. The uropods of Asellidae are very easily broken off and it is difficult to distinguish regenerated appendages from those which have had a normal growth without injury.

This species is distinguished at once from all the other species of the genus by the presence of distinct though very small eyes. In this respect it is the most primitive species of the genus. It may also be distinguished by the relatively shorter antennae, the form of the second thoracic limbs and especially by the form of the first pleopod of the male. The latter is curiously similar to the same appendage in *Asellus aquaticus*, which is considered to be the most primitive of the species of *Asellus*, and *C. kawamurai* is, I think, the most primitive of the species of *Caecidothea*.

This new form removes one more of the characters separating the genus *Caecidothea* from *Asellus*, the presence of eyes in the latter and their absence in the former. There remains only the general form of the body and the size of the head and pleon to separate the two, and among the known species of *Asellus* and *Caecidothea* there are all grades of shape, which would make a continuous series of connecting forms. The validity of the genus *Caecidothea* is indeed doubtful.

This species is a most interesting addition to the fauna of Japan. Its nearest allies are all American species, found in subterranean caves and springs in Kentucky, Tennessee, Texas and so on.

Sub-order *FLABELLIFERA*.

Fam. CYMOTHOIDAE.

Genus **Tachaea**, Sch. et Mein.

Tachaea chinensis, Thielemann.

(Pl. XVI, figs. 16–18.)

T. chinensis, Thielemann, 1910, p. 18, text figs., 12-20.

Localities :—

CHINA.

N.E. end of Tai Hu, near Moo Too, China, 1. xii. 15, 2 females, 7 mm.

Outskirts of Shanghai, in ditches and ponds, adhering to the carapace of *Caridina nilotica* subsp. *gracilipes* and *Palaemonetes sinensis*, 3 immature, 3-4·5 mm.

JAPAN.

Ogura Pond, near Kyoto, from *Leander paucidens*, 6 specimens, 6-9 mm. Lake Kasumi-ga-Ura, on the east coast 15. x. 15, from the carapace of *Leander paucidens*, sixteen, 6-9 mm.

These specimens, both from China and Japan, differ from the description and figures given by Thielemann in two particulars, (i) there is a distinct lacinia mobilis on the mandible (Pl. XVI, fig. 16), tipped by two or three small setae (ii) the single strong curved spine on the first maxilla (Pl. XVI, fig. 17) is longer than Thielemann shows and more like that figured by Stebbing for *T. spongillicola*.

These small differences bring *T. chinensis* much more closely in agreement with *T. spongillicola* and I am inclined to doubt whether they are really separate species. But I have not seen specimens of Stebbing's species and the question cannot be decided until specimens are compared from both localities.

Hansen (1890) in his monograph on this and allied genera, figures a six-jointed maxillipede for the type species *T. crassipes* and states in the diagnosis of the genus that the second and third joints are fused, thus accounting for the reduction in number of the joints of the appendage from seven to six.

Stebbing (1907) in describing *T. spongillicola*, says that the maxillipedes are decidedly only six-jointed and he explains the reduction in this species as due to the fusion of the sixth and seventh joints. A careful comparison and measurements of his figure show that in his specimen the second and third joints were not fused and that the explanation of the reduction in the number of joints is really due to the fusion of the sixth and seventh. *T. spongillicola* therefore is not in agreement with the generic diagnosis of *Tachaea* in this respect.

Thielemann describes and figures the maxillipedes of *T. chinensis* as five-jointed, and it is evident that, in this case, the second and third, and sixth and seventh joints are fused.

T. chinensis would then appear to combine the characters of *T. crassipes* and *T. spongillicola* as far as the maxillipedes are concerned. But these appendages are very small and delicate and the joints very difficult to make out and the condition which I have noticed in these Chinese and Japanese specimens may possibly explain the apparent differences in the three species. On the elongate second joint there are traces, visible at the sides, of a suture, but it is not continued across the joint. I take it that this represents a partial separation of the second and third joints and a similar incomplete suture is visible on the terminal joint indicating the partial separation of the sixth and seventh joints (Pl. XVI, fig. 18).

But in neither case could I trace the suture right across the joints, and I should describe the maxillipedes as five-jointed with partial separation of the second and last joints into two. It looks to me as if Stebbing saw a similar partial suture between the second and third joints, but not between the sixth and seventh joints in his species, while Thielemann does not mention either. My point is that the apparent differences in the descriptions and figures of the maxillipedes of the three species are not nearly so important as they seem at first and may be explained by the delicacy of the appendages and the difficulties of seeing the sutures.

There are three species of *Tachaea* known from fresh water, *T. lacustris*, Weber, from Sumatra, *T. spongillicola* from Calcutta, and *T. chinensis* from China and Japan. These three species are very closely related to one another and structurally there seems very little to distinguish them. But each has a very distinct habit. *T. lacustris* was found on Cyprinoid fishes, *T. spongillicola* in the canals of a freshwater sponge and the present specimens of *T. chinensis*, both from China and Japan, were found clinging to the carapaces of various freshwater Macrura, *Caridina*, *Palaemonetes* and *Leander*.

Thielemann's type specimens were obtained in the market at Shanghai, so the present collection provides the first indication of its habit and mode of life. I could not detect any differences between the Chinese and Japanese specimens. Both are characterised by a profuse development of black arborescent chromatophores on the body and the appendages.

"All my specimens were from pure fresh water, and were associated with small prawns of various genera. The common Indian species (*T. spongillicola*, Stebbing) is also found adhering to the external surface of the carapace of small freshwater prawns, especially when young, as well as in the canals of *Spongilla*. In neither species is the association of a permanent nature. *N. A.*"

Genus **Ichthyoxenus**, Herklots.

Ichthyoxenus japonensis, Richardson.

I. japonensis, Richardson, 1913, p. 561, text figs 4–6.

Locality:—Lake Biwa, Japan, from *Acheilognathus* sp., February, 1915, six females, five males (presented by Dr. T. Kawamura).

Richardson's type specimens were taken from *Acheilognathus cyonostigma* (Jordan and Fowler) captured in Lake Biwa, and other specimens were found on various species of *Acheilognathus* and *Gnathopogon* from Lake Yago, Funayado, and Lake Biwa. The species is therefore fairly widely distributed in the freshwater systems of Japan. The present specimens are in agreement with Richardson's description and figures.

Family SPHAEROMIDAE.

Genus **Exosphaeroma**, Stebbing.

Exosphaeroma oregonensis, Dana ?

(Pl. XVI, figs. 1-5.)

E. oregonensis, Thielemann, 1910, p. 51, text figs. 41-47.

Locality:—Whangpoo River, about 10 miles below Shanghai, 6-7 metres, 10. xii. 15, on bottom of hard mud, eight specimens up to 6 mm. (water fresh but tidal).

Si Dong Ding, Tai Hu, China, $2\frac{1}{2}$ metres, 1. xii. 15, on muddy bottom with *Potamogeton* and other weeds, two specimens (fresh water).

S.E. end of Si Dong Ding, Tai Hu, China, 3. xii. 15, on lower surface of stones, about 50 specimens (fresh water).

I think this is the same species as that recorded from Japan by Thielemann (1910), but I am not so sure that it is Dana's species. Both this species and the following one have given me considerable trouble in their identification and I think it well to describe the appearance of the pleopods as they looked when dissected from spirit specimens, because it was mainly from this that I detected the presence of two species in this collection and also because the pleopods seem to me to depart from the descriptions of the pleopods of the Hemibranchiata as given by Hansen.

Pleopod 3 (Pl. XVI, fig. 3). Endopod with an opaque rather fleshy area on the inner proximal portion as indicated by the shading in my drawing. Otherwise both rami are transparent and I was not able to detect with certainty any regular branchial plications. Endopod with numerous plumose setae at the apex. Exopod two-jointed, distal joint edged with plumose setae all round, proximal joint without setae on the inner margin, but fringed with short setae on the outer edge.

Pleopod 4 (Pl. XVI, fig. 4). Endopod quite opaque and fleshy all over with two or three short plumose setae at the apex. Exopod two-jointed, inner proximal two-thirds, opaque and fleshy, rest transparent, a few short setae on outer edge of proximal joint, distal joint with a few (six or seven) plumose setae on its margins.

Pleopod 5 (Pl. XVI, fig. 5). Both rami thick and fleshy and opaque, exopod fusion of the sixth and seventh joints. A careful comparison and measurements of his figure show that in his specimen the second and third joints were not fused and that the explanation of the reduction in the number of joints is really due to the fusion of the sixth and seventh. *T. spongillicola* therefore is not in agreement with the generic diagnosis of *Tachaea* in this respect.

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Si Dong Ding, Tai Hu, China, 2½ metres, 1. xii. 15, on muddy bottom with *Potamogeton* and other weeds, two specimens (fresh water).

S.E. end of Si Dong Ding, Tai Hu, China, 3. xii. 15, on lower surface of stones, about 50 specimens (fresh water).

I think this is the same species as that recorded from Japan by Thielemann (1910), but I am not so sure that it is Dana's species. Both this species and the following one have given me considerable trouble in their identification and I think it well to describe the appearance of the pleopods as they looked when dissected from spirit specimens, because it was mainly from this that I detected the presence of two species in this collection and also because the pleopods seem to me to depart from the descriptions of the pleopods of the Hemibranchiata as given by Hansen.

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Pleopod 4 (Pl. XVI, fig. 4). Endopod quite opaque and fleshy all over with two or three short plumose setae at the apex. Exopod two-jointed, inner proximal two-thirds, opaque and fleshy, rest transparent, a few short setae on outer edge of proximal joint, distal joint with a few (six or seven) plumose setae on its margins.

Pleopod 5 (Pl. XVI, fig. 5). Both rami thick and fleshy and opaque, exopod two-jointed, outer margin of proximal joint with a few short setae, distal joint of peculiar shape the pointed apex of the distal protuberance studded with small spines, a pad of similar spinules on the inner proximal margin of the distal joint; endopod without setae.

None of the males which I dissected had an appendix masculina on the second pleopod but as none of my specimens measured more than 6 mm., they may not have been fully grown. I could not detect with certainty any definite branchial plications on any of the pleopods.

The general form of this species is shown on pl. XVI, fig. 1. This figure agrees very closely with Thielemann's figure and my specimens agree with his description very closely except that pleopod four has fewer plumose setae on each ramus.

As Thielemann points out this species differs from Hansen's description of the pleopods of the hemibrachiate Sphaeromids in having plumose setae on the fourth pleopods. Hansen says that the fourth and fifth pleopods are never furnished with such setae.

I have examined six specimens of *E. oregonensis*, Dana, sent me by the United States National Museum, from Sitka, Alaska, on the beach. Five of these are males measuring 10 mm. and one a female measuring 8 mm. The pleopods agree substantially with those I have described above, the fourth pair has plumose setae on each ramus, more numerous than in my specimens but otherwise the same. The males also possess an appendix masculina, from which I have concluded that if my specimens belong to the same species, the males are still immature.

All the males of these Alaskan specimens have a dense fringe of hairs on the fourth, fifth and sixth joints of the fourth and fifth pairs of thoracic limbs, but these hairs are not present in the single female. Hansen says that the thoracic limbs of the hemibranchiate Sphaeromids never exhibit sexual differences. If the above specimens from Alaska have been correctly interpreted, *E. oregonensis* forms an exception to this general statement. None of the Chinese specimens exhibit these hairs, but they are otherwise so closely in agreement with the Alaskan specimens that I have regarded them as immature and not fully grown, the appendix masculina of the second pleopods in the male and the fringe of hairs on the fourth and fifth thoracic limbs being both characters denoting sexual maturity.

If all the records ascribed to *E. oregenensis* refer to the same species, it has a very wide distribution in the shallow waters of Eastern Asia from China to Kamtschatka and Western America from Alaska to California. It is also capable of living equally well in pure sea-water or in fresh water as in China or Japan and in Alaska as recorded by Richardson.

It is possible that the specimens recorded by Thielemann from Japan and here from China are brackish water varieties of the type, characterised by their smaller size and the modification of their secondary sexual organs and it is also conceivable that the general appearance of the pleopods and the absence of definite plications in my specimens from China, may be correlated with the special habitat in which they were found.

Exosphaeroma chinensis, sp. nov.

(Pl. XVI, figs. 6-15.)

Locality:—Edge of Whangpoo River, between Shanghai and Wu Sung, China, on weeds and lower surface of stones, sixteen specimens up to 6 mm., $\frac{9926}{10}$. [Types.]

Whangpoo River, about 10 miles below Shanghai, 6-7 metres, 10. xii. 15, on bottom of hard mud, one specimen, $\frac{9359}{10}$.

This species is very closely related to the preceding one and it will be sufficient to point out the differences between the two. In general appearance the two forms are almost exactly alike and the figure which I have given of *E. oregonensis* would do equally well for this species. I have also figured the first and second antennae (Pl. XVI, figs. 6-7) the maxillipede and the second and eighth thoracic limbs (Pl. XVI, figs. 9-11) of *E. chinensis*. They present no marked differences from those of *E. oregonensis*, but will be useful for comparison with Thielmann's figures of the latter species.

E. chinensis differs from *E. oregonensis* in the following points:—

(1) The epistome is smaller and its postero-lateral processes much shorter than in *E. oregonensis*. Compare my figure (pl. XVI, fig. 8) with that given by Thielemann.

(2) The exopod of the uropod is much smaller compared with the endopod, than in *E. oregonensis*. Compare Pl. XVI, fig. 2 with Pl. XVI, fig. 15.

(3) In the pleopods.

(a) Although *E. chinensis* is only 6 mm. in length, the males possess an appendix masculina. (Pl. XVI, fig. 12).

(b) Pleopod three has both rami transparent without any opaque or branchial area.

(c) Pleopod four (Pl. XVI, fig. 13) has the endopod completely opaque and branchial and without plumose setae; the exopod is completely transparent, without branchial area, two-jointed, distal joint with several plumose setae on its margins.

(d) Pleopod five (Pl. XVI, fig. 14) has both rami opaque and completely branchial, exopod two-jointed, both rami without plumose setae, distal joint of the exopod not of peculiar shape and without the spinulose protuberance seen in my specimens of *E. oregonensis*.

A comparison of the figures I have given of the pleopods of *E. chinensis* with those given for *E. oregonensis* will bring out these differences.

To judge from the specimens in this collection, *E. chinensis* is common in the tidal waters connecting the Tai Hu with the sea but was not found in the Tai Hu itself, whereas *E. oregonensis* is most abundant in the Tai Hu and sparingly found in the Whangpoo River. In other words *E. oregonensis* can tolerate or even prefers a much more purely freshwater habitat than *E. chinensis*.

Sub-order *VALVIFERA*.

Family IDOTEIDAE.

While it is comparatively easy to decide that the species described below is new to science, it is a much more difficult matter to determine to which of the existing genera of the family it should be referred. In my endeavours to arrive at a proper conclusion of this question I have encountered many discrepancies in existing generic definitions and have experienced much of the confusion which still exists in this family, in spite of the work of recent authors. There is much diversity of opinion and no little inconsistency as to what constitutes a generic character and it is not an infrequent experience to find one character used as a basis for generic separation in one group of species and as cheerfully ignored in another group by the same author. Much of the existing chaos is due to the imperfect descriptions given by earlier authors and as these early species are retaken and recognised and their diagnoses brought up to date in the light of accummulated knowledge, order is slowly evolving itself out of the confusion. But much still remains to be done, and a thorough revision of the family is needed. This is not the place to attempt to do this, for the material at my disposal is inadequate. But I may perhaps be allowed to point out some of the discrepancies and inconsistencies which I have encountered in my search through the literature, in the hope that some other worker with more abundant material may eventually elucidate my difficulties.

Collinge (1918) in a paper on the oral parts of the Idoteidae has summarised the existing genera of the family in a table, giving the number of spines on the inner lobe of the first maxilla, the number of joints on the palp of the maxillipede and the number of complete segments and sutures in the metasome.

Excluding the Glyptonotinae and Mesidoteinae and the anomalous genera *Symmius*, Richardson and *Chiriscus*, Richardson, we find that the remaining genera in Collinge's table may be grouped into three divisions according to the number of joints in the palp of the maxillipede, as follows:—

PALP OF THE MAXILLIPEDE FIVE-JOINTED.

Zenobiana, Stebbing; *Pentidotea*, Richardson; *Engidotea*, Barnard; *Cleantiella*, Richardson; *Paridotea*, Stebbing; *Glyptidotea*, Stebbing; *Pentias*, Richardson; *Crabyzos*, Spence Bate.

PALP OF THE MAXILLIPEDE FOUR-JOINTED.

Idotea, Fabricius; *Euidotea*, Collinge; *Colidotea*, Richardson; *Eurymmerus*, Richardson; *Erichsonella*, Benedict; *Synisoma*, Collinge.

PALP OF THE MAXILLIPEDE THREE-JOINTED.

Edotia, Guér.-Mén.; *Synidotea*, Harger.

Our species falls into the first of these three groups in having the palp of the maxillipedes five-jointed. The genera in this group are separated from one another mainly on the characters of the segmentation of the metasome. I reproduce here that part of Collinge's table which deals with this character.

	Metasome. Number of Segments.	Sutures.
Zenobiana	3-5	(1)
Pentidotea	3	1
Engidotea	2	2
Cleantiella	2	(2)
Paridotea	1	3
Glyptidotea	1	3
Pentias	1	3
Crabyzos	1	2

We may complete the table by adding that the type species of *Zenobiana* has one suture on the metasome and, according to Miers' figure of *Cleantis isopus*, the type of the genus *Cleantiella*, this genus has two sutures on the metasome.

It will be seen that the genera *Paridotea*, *Glypidotea* and *Pentias* are identical in the characters so far noticed and it is difficult to see on what grounds they are separated.

Cleantiella and *Engidotea*, which agree in the form of the maxillipedes and in the segmentation of the metasome, are distinguished readily by the flagellum of the second antenna which in the former is uni-articulate and in the latter, multiarticulate.

In attempting to place our species in one of the genera of this group we meet with our first difficulty. It has four segments in the metasome, and one suture, and is therefore apparently referrable to the genus *Zenobiana*. But this conclusion is open to a good many objections which it is necessary to inquire into.

Collinge's table of genera of the Idoteidae does not include the genus *Cleantis*, Dana. He presumably considers this genus as a synonym of *Zenobiana*, an opinion I have myself expressed previously. *Cleantis* was instituted by Dana in 1849 for the type species, *C. linearis*, Dana, captured off N. Patagonia. The genus and species were described and figured more fully in Dana's great work on the Crustacea of the United States Exploring Expedition. From that work, I have transcribed the following generic definition:—Outer antennae much the longer, not geniculate, five to six-jointed, without a flagellum. Feet of the fourth pair very much shorter than the third; last four pairs gradually increase in length. Outer abdominal plates or opercula having a small lamina attached inside at the articulation.

We may remark at once, that if Dana's type species really had uropods of the kind he describes (and his description is borne out by his figure, pl. 46, fig. 9k) none of the species subsequently added to the genus *Cleantis* have been correctly referred. No notice of this remarkable character of the genus *Cleantis* seems to have been taken by subsequent writers and I can find no reference to the form of the uropods in species referred to this genus except in the case of *C. strasseni*, in which Thielemann figures a uropod of the type more normally met with in Idoteidae, a flattened plate, divided by a suture near the distal end into a large proximal joint, the protopodite, and a small distal joint, the endopodite, with a strong plumose seta at its base on the outer corner of the basipodite. The form depicted by Dana, in which both endopodite and exopodite are present, is confined to the genera *Glyptonotus*, *Chiridotea*, *Macrochiridothea*, and *Mesidotea*. It seems almost certain that Dana was in error on this point, but the matter is one that wants clearing up before the status of the genus *Cleantis* can be satisfactorily settled.

Further with regard to the maxillipede, Dana only figures three joints in the palp. Here again Dana is probably in error, but it is most important to know how many joints there are in the palp of the type species, for this character is of first value for the classification of the species into genera.

Two other characters in Dana's definition of the genus deserve special mention. The flagellum of the antennae is uni-articulate and the fifth pair of thoracic limbs is conspicuously shorter than the remainder.

It will be recognised, therefore, that for two important characters, the palp of the maxillipedes and the form of the uropods, our information with respect to the type species of *Cleantis* is deficient or of doubtful accuracy.

It is clear that if Dana's description is borne out by subsequent examination of the type species, none of the species referred to the genus by later authors can remain within its limits. If Dana was in error on the two characters named, what is the extent of his error ?

It is now necessary to consider the species referred to the genera *Cleantis* and *Zenobiana*.

The genus *Zenobia* was instituted by Risso in 1826 for two species, *Zenobia prismatica* and *Zenobia mediterranea* both of Risso. These two species have since been shown to be synonymous. Miers, (1881) in his revision of the family treats *Zenobia* as a subgenus of the genus *Idotea*, characterised as follows:—"Post-abdomen composed of four or five distinct segments, visible in a dorsal view, (species small, or minute, with a few-jointed antennal flagellum). Zenobia ?" To this sub-genus, as thus defined, Miers refers both species of Risso and two new ones, *Idotea* (*Zenobia*) *whymperi*, Miers, and *I.* (*Z.*) *danai*, Miers.

Dollfuss (1895) restored Risso's name to full generic rank and in the same year Stebbing pointed out that the name was preoccupied and changed it to *Zenobiana*.

No other species of the genus have been described as such, but Issel (1913) definitely regards the genus *Cleantis* of Dana as a synonym and refers to all the species of *Cleantis* as species of *Zenobiana*. Bate and Westwood expressed very much the same opinion and in 1911 I pointed out that if this opinion was accepted, Dana's name had priority.

The following species of the genus *Cleantis* have been described subsequent to the type species, *C. linearis*, Dana :—

- *C. planicauda*, Benedict.
- *C. tubicola*, G. M. Thomson.
- *C. granulosa* Heller.
- *C. isopus*, Miers.
- *C. heathii*, Richardson.
- *C. occidentalis*, Richardson.
- *C. strasseni*, Thielemann.
- *C. japonica*, Richardson.

In addition, Miers, 1881, referred three species to the genus, which have since been placed in the genus *Erichsonella*, Benedict (=*Erichsonia*, Dana) and do not concern us here.

Of the above eight species of *Cleantis*, *C. isopus*, Miers has since been made the type of a new genus *Cleantiella*, Richardson, by reason of the "differences in the shape of the body, which is broader and more flattened, and in the character of the legs, and to the fact that the abdomen is composed of but two segments."

It will be useful to set out in tabular form the characters of the species of *Cleantis*, *Cleantiella* and *Zenobiana*, as regards the palp of the maxillipedes, the segmentation of the metasome and the flagellum of the antennae.

	Joints in palp of Maxillipede.	*Metasome.*		*Flag. of Antennae.*
		Segments.	*Sutures.*	
ZENOBIANA :—				
prismatica, Risso	5	4	1	{ 1 – 4 ; 1 ?
whymperi, Miers	..	4	0	1
danai, Miers	..	5	?	2
CLEANTIS :—				
linearis, Dana	3 ?	3	1	1
planicauda, Benedict ..	5	4	1	1
japonica, Richardson ..	5	4	1	1
occidentalis, Richardson ..	4	4	1	1
heathii, Richardson ..	4	3	1	3
granulosa, Heller	4	5	?	1
strasseni, Thieleman ..	4	1	3	5
tubicola, Thomson.. ..	..	..	..	..
CLEANTIELLA :—				
isopus, Miers	5	2	2	1

Apart from the uncertainty about the number of joints in the maxillipede palp in *Cleantis linearis*, Dana, we see that the remaining species in the above table have either four or five joints in this appendage. This difference has been used as a generic character in other members of the family.

The segmentation of the metasome and the number of sutures representing incomplete segments show the greatest diversity and, if this character is also to be used to separate genera, only two in the above list of species could be referred to the same genus, *Cleantis planicauda* and *C. japonica* and a new genus would be required for each of the other species!

The species in the above list show a great resemblance to one another in external form. They are all small, parallel-sided, linear species, the majority tubicolous in habit. The only marked exception is *Cleantiella isopus*, which has a quite different shape from the rest, and has, for this among other reasons, been made the type of a separate genus.

Most of the species agree in having the fifth thoracic limbs shorter than the remainder, without a dactylus and with peculiar spines on the inner surface. *C. isopus* again forms an exception, to judge from Miers' figure, and Richardson says definitely that in *C. heathii* there is no perceptible difference in the length of the legs.

Further, while the majority of the species have the flagellum of the second antennae composed of a single joint, *C. heathii* and *C. strasseni* have three and five joints in this flagellum. Moreover, in *Zenobiana prismatica*, the sexes differ in this respect according to Collinge, the male having 1–4 joints in the flagellum of the second antenna and the female only one with occasionally traces of a second. Issel has noted marked variation in this speci es in this respect. The species, *C. strasseni* appears to be quite an anomalous form. In the segmentation of the metasome it approaches the genus *Erichsonella*, but the second antennæ have a multi-articulate flagellum which is not characteristic of either *Erichsonella* or *Cleantis* according to the original generic definitions.

Enough has been said to indicate the great confusion which exists in the classification of this small group of species on lines similar to that employed for other members of the family.

More precise and detailed information is required about the existing species, with special attention paid to the maxillipedes, segmentation of the metasome and antennal flagellum. We require a detailed study of the variation of the segments and sutures of the metasome and of the joints in the antennal flagellum in any one species or group of species in order to arrive at a conclusion as to their value for classificatory purposes. It is not possible to attempt a revision of the above group of species here, for I have no material at my command, but it has seemed to me well to call attention to the discrepancies and anomalies which at present exist, in the hope that some worker with the material at his command will take the question up and elucidate it.

It will be seen, too, that it is almost impossible to be certain of the generic position of the new species described below.

I do not feel it would be right to burden literature with a new generic name when investigation may remove the difficulties mentioned above, and I therefore refer the species for the moment to the genus *Cleantis*, Dana, emphasising that the species has five joints in the palp of the maxillipedes, four segments and one additional pair of sutures in the metasome, a two-jointed flagellum to the second antennae in both sexes, the fifth pair of thoracic limbs markedly shorter than the rest, and the uropoda without exopodite and with a plumose seta.

Cleantis annandalei, sp. nov.

Pl. XVII, Figs. 1-11.

Locality.—Whangpoo River, China, about 10 miles below Shanghai, 5-7 metres, 10. xii. 15, one female, 13 mm., two males, 12 and 10 mm., $\frac{9358}{10}$. In fresh water.

Description.—Body (fig. 1) linear in shape, not parallel-sided but somewhat broader in the centre than either at the anterior or posterior ends, about $3\frac{1}{2}$ times as long as broad; head somewhat vaulted, the front margin sinuate with a median depression, a deeply impressed groove, rather curved, running across the posterior part, eyes small, dorsally placed, rather in front of the middle of the lateral margins of the head; second thoracic segment without coxal plates, the lateral parts produced forward; third to eighth thoracic segments with distinct coxal plates visible in the dorsal view, those of the third to fifth segments small, not occupying the whole of the lateral margins of the segments; those of the sixth to eighth segments extending the whole width of the segments; metasome not quite half as long as the body, composed of four segments, that is three complete segments and the telsonic segment, with an additional pair of sutures on the anterior part of the latter, posterior margin of the telsonic segment terminating in two acute processes between which the apex is emarginate.

Antennules (fig. 2) small, extending to the distal end of the second joint of the peduncle of the antennae, the three joints of the peduncle successively narrower than the preceding joint, first and third joints equal in length and longer than the second, flagellum consisting of one minute joint tipped by a few short setae.

Antennae (fig. 3) reaching somewhat posterior to the hinder margin of the third thoracic somite, first three joints of the peduncle short, fourth and fifth long and about equal in length to each other, flagellum about one and a half times as long as the fifth joint of the peduncle and consisting of one very long joint and a very small terminal joint, the whole flagellum with a clothing of fine hairs on each margin, among which a few stronger setae can be detected.

First maxilla (fig. 4) with about eleven or twelve terminal spines, some of which are denticulate, on the outer lobe, and three plumose spines on the inner lobe.

Maxillipede (fig. 5) with the coxopodite in two portions, basipodite narrower than the epipodite, and a little shorter, inner lobe with two coupling hooks and an armature of strong plumose spines at the apex, palp of five joints, the first joint small, the second and third cup-shaped, the fourth joint the longest and oval in shape, the fifth joint small but distinctly marked off.

Second thoracic limb (fig. 6) rather stout, outer distal corner of the merus somewhat produced, with a group of long setae at the apex of the process, carpus small, propodus longer than the merus and carpus combined and somewhat expanded, dactylus long and narrow, not quite as long as the propodus and with a joint near the distal end; the merus, carpus and propodus bear groups of spiniform setae on their inner margins, while the dactylus has two or three small spinules near its tip and a pencil of setae on the outer edge just where the terminal portion is marked off.

The third and fourth thoracic limbs (fig. 7) are of essentially the same form as the second, somewhat longer, with the carpus longer and more developed and the propodus not so much expanded.

Fifth thoracic limb (fig. 8) quite short, not much more than 2/3 of the length of either the fourth or sixth thoracic limbs, without a dactylus, with a clothing of fine hairs on the outer margins of all the joints, and groups of strong spines on the merus, carpus and propodus. Sixth to eighth thoracic limbs (fig. 9) increasing successively in length and of the form shown in the figure. In the eighth thoracic limb the carpus is about equal to the propodus, not quite twice as long as the dactylus. All the joints bear a fringe of fine hairs on the outer margins and the propodus and carpus several groups of strong setae.

The distal part of the uropod is shown in fig. 10. The endopodite alone is present and on the outer distal corner of the basal joint there is a strong and long plumose spine.

Second pleopods of the male (fig. 11) with an appendix masculina about equal in length to the branches, suddenly narrowing near the tip to an acute apex.

Length of an adult female, 13 mm. of an adult male, 12 mm., and of an immature male, 10 mm.

This interesting species, which I have great pleasure in associating with its discoverer, may be distinguished at once by the shape of the posterior end of the metasome. No other species assigned to the genera *Zenobiana*, *Cleantis* or *Cleantiella* is at all like it in this respect. It is also unlike the majority of species of these genera in not having the body of equal width throughout. It agrees with *Cleantis japonica* and *C. planicauda* in the maxillipedes and in the segmentation of the pleon, but both these species have parallel-sided bodies and evenly rounded extremities to the metasome.

The short fifth thoracic limbs suggest a similarity in habit to the tubicolous forms of the above three genera, but the shape of the body is hardly that of a tubicolous species. The minute terminal second joint of the peduncle of the second antenna is a feature which is probably common to other species though not so far noticed.

Sub-order Oniscoidea.

Family LIGIIDAE.

Genus **Ligia**, Fabricius.

Ligia exotica, Roux.

L. exotica, Chilton, 1916, p. 462, text-figs. 1-22.

Locality:—Station 22, Talé Sap, on shore of channel between Koh Yaw and mainland, two males, 18 mm.

Chilton in the memoir cited above has redescribed and figured this species very completely and I have nothing to add to what he has written.

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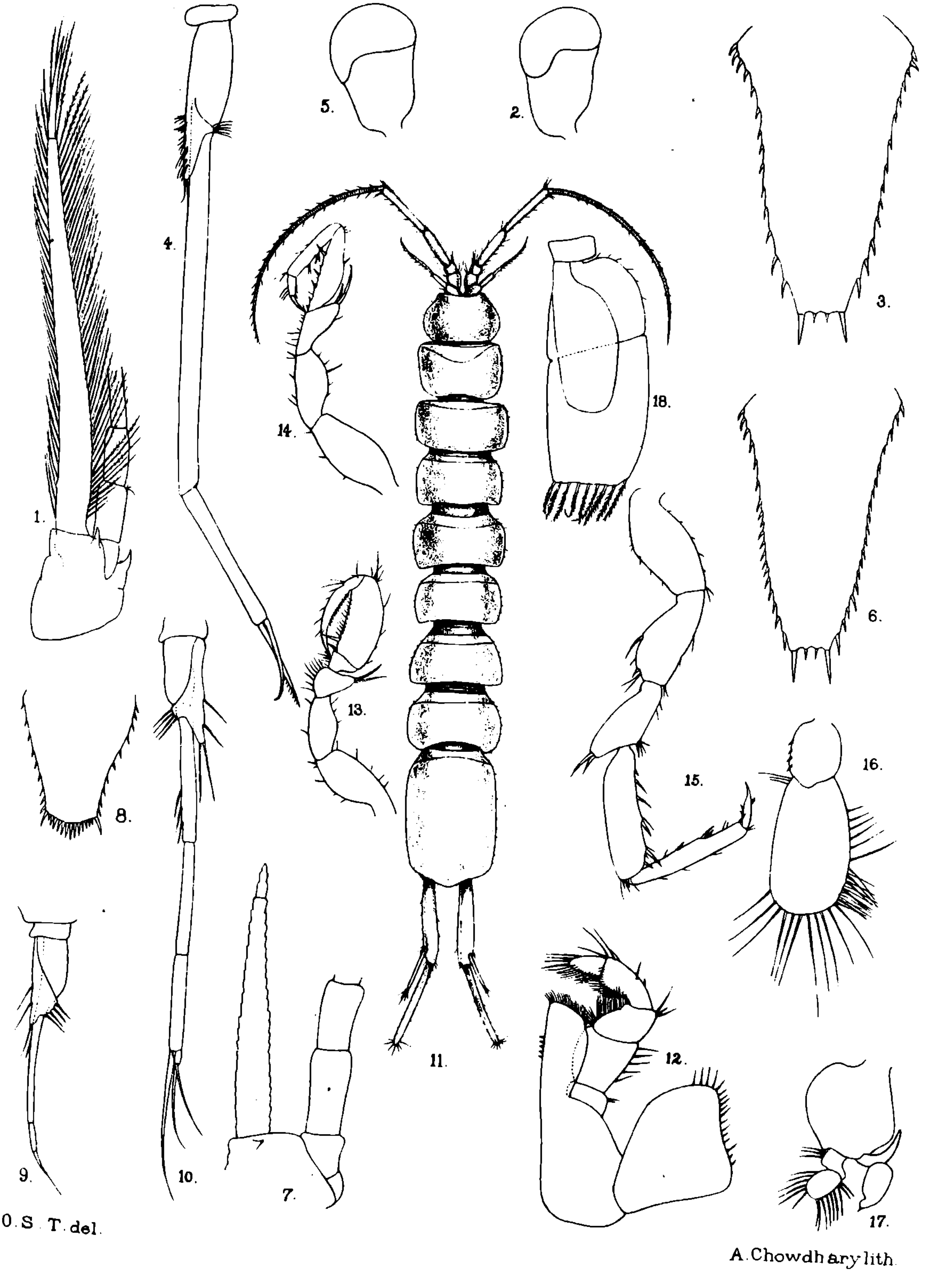
EXPLANATION OF THE PLATES.

Plate XV.

FIG. 1.—*Neomysis awatschensis*, Brandt. Antennal scale × 50.
,, 2. ,, ,, ,, Eye × 33.
,, 3. ,, ,, ,, Telson × 50.
,, 4. ,, ,, ,, 4th pleopod of male, × 50.
,, 5.—*Neomysis nigra*, Nak. Eye × 33.
,, 6. ,, ,, ,, Telson × 65.
,, 7.—*Nanomysis siamensis*, gen. et. sp. nov. Antennal scale × 100.
,, 8. ,, ,, ,, Telson × 100.
,, 9. ,, ,, ,, 3rd pleopod of male × 100.
,, 10. ,, ,, ,, 4th ,, ,, ,, × 100.
,, 11.—*Caecidothea kawamurai*, n. sp. Adult male × 7.
,, 12. ,, ,, ,, Maxillipede × 33.
,, 13. ,, ,, ,, Second thoracic limb × 14.
,, 14. ,, ,, ,, Third thoracic limb × 14.
,, 15. ,, ,, ,, Eighth ,, ,, × 14.
,, 16. ,, ,, ,, First pleopod of male × 14.
,, 17. ,, ,, ,, Second pleopod of male × 33.
,, 18. ,, ,, ,, Third pleopod of male × 33.

Plate XVI.

FIG. 1.—*Exosphaeroma oregonensis*, Dana, × 17.
,, 2. ,, ,, ,, Telson and uropods × 17.
,, 3. ,, ,, ,, Third pleopod × 33.
,, 4. ,, ,, ,, Fourth ,, × 33.
,, 5. ,, ,, ,, Fifth ,, × 33.
,, 6. ,, *chinensis*, n. sp. Antennule × 65.
,, 7. ,, ,, ,, Antenna × 45.
,, 8. ,, ,, ,, Epistome × 65.
,, 9. ,, ,, ,, Maxillipede × 65.
,, 10. ,, ,, ,, Second thoracic limb × 45.
,, 11. ,, ,, ,, Eighth ,, ,, × 33.
,, 12. ,, ,, ,, Second pleopod of male × 33.
,, 13. ,, ,, ,, Fourth pleopod of male × 33.
,, 14. ,, ,, ,, Fifth pleopod of male × 33.
,, 15. ,, ,, ,, Uropod × 33.
,, 16.—*Tachaea chinensis*, Thielemann. Mandible × 65.
,, 17. ,, ,, ,, First maxilla × 65.
,, 18. ,, ,, ,, Maxillipede × 65.



O. S. T. del.

A. Chowdhary lith.

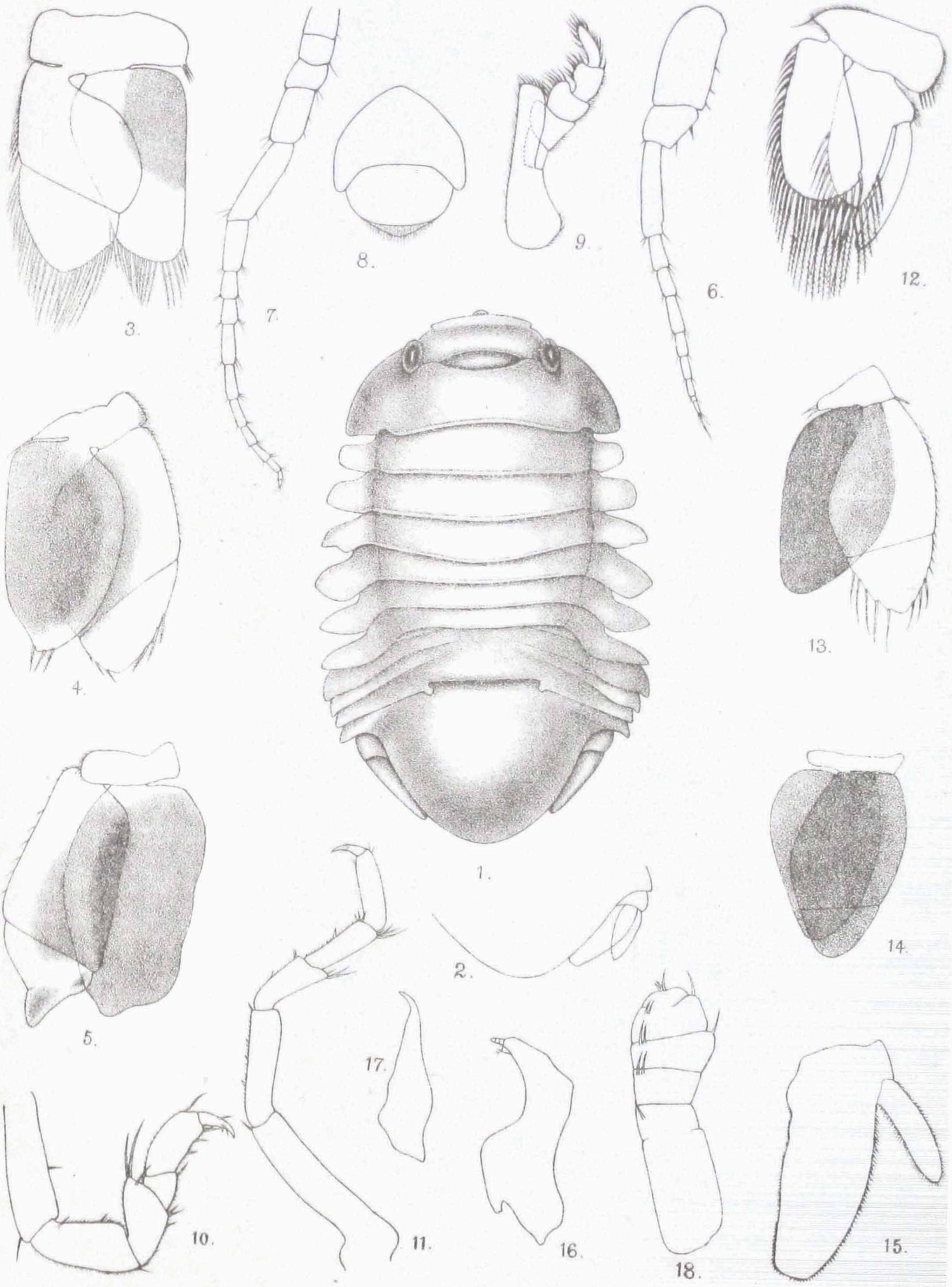


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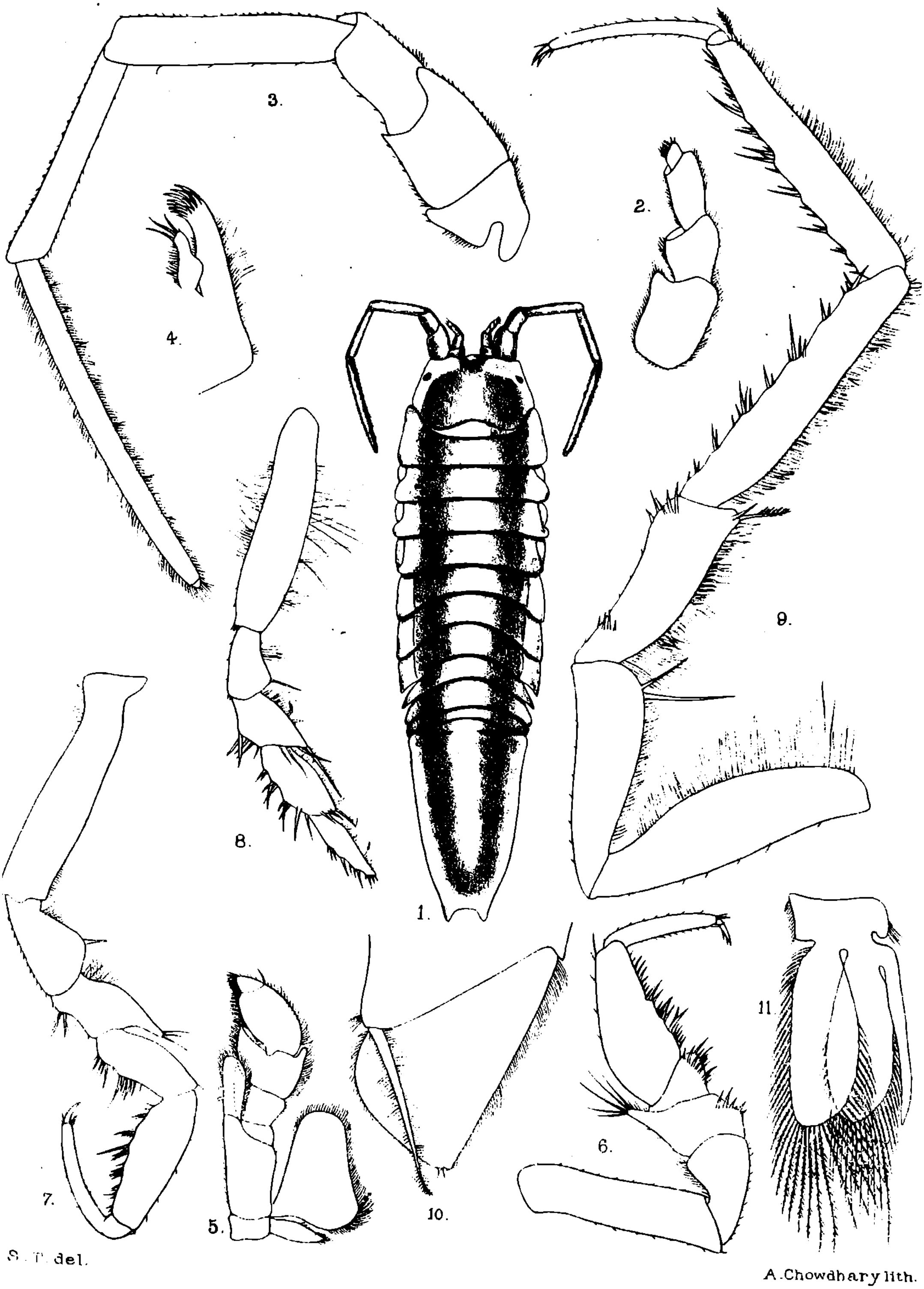
Plate XVII.

Cleantis annandalei n. sp.

FIG. 1.—Dorsal view of adult male × 33.
,, 2.—Antennule × 33.
,, 3.—Antenna × 33.
,, 4.—First maxilla × 20.
,, 5.—Maxillipede × 33.
,, 6.—Second thoracic limb × 20.
,, 7.—Third thoracic limb × 20.
,, 8.—Fifth ,, ,, × 20.
,, 9.—Eighth ,, ,, × 20.
,, 10.—Distal joint of uropod × 20.
,, 11.—Second pleopod of male × 20.



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MEMOIRS

OF THE

ASIATIC SOCIETY OF BENGAL

VOL. VI, pp. 435—459.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

EDITED BY N. ANNANDALE, D.Sc., F.A.S.B.

PART VIII.

CALCUTTA:

PRINTED AT THE BAPTIST MISSION PRESS, AND PUBLISHED BY
THE ASIATIC SOCIETY, 1, PARK STREET.

1922.

Price Rs. 2; or 3*s.*

18-4-22.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

PART VIII.

CONTENTS.

Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

AMPHIPODA WITH NOTES ON AN ADDITIONAL SPECIES OF ISOPODA.

By W. M. TATTERSALL, *D.Sc.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

AMPHIPODA WITH NOTES ON AN ADDITIONAL SPECIES OF ISOPODA.

By W. M. TATTERSALL, *D.Sc., Keeper of the Manchester Museum.*

[Plates XVIII–XXI.]

This report completes the account of the Crustacea from Dr. Annandale's tour in the Far East, submitted to me for examination. It includes notes and descriptions of the Amphipoda collected in China and Japan, some terrestrial Amphipoda from the Botanical Gardens at Singapore, and an additional Isopod which I discovered in one of the tubes of Amphipoda.

The list of species dealt with is as follows:—

ISOPODA.

Cyathura carinata (Kröyer). China.

AMPHIPODA.

Monoculodes limnophilus, n. sp. China.
Atyloides japonica, n. sp. Japan.
Gammarus annandalei, n. sp. China, Japan.
Gammarus pulex (Linn). Japan.
Talorches ia japonica, n. sp. Japan.
Talorchestia malayensis, n. sp. Singapore.
Grandidierella megnae (Giles). China.

The collection dealt with here supports in the main the conclusions drawn from the study of the Mysidacea and Isopoda.

The Tai-Hu, though a freshwater lake, has a very marked marine element in its fauna. This marine element has been derived from two sources: an immigration from the south, and one from the north.

The southern element is representated among the Amphipoda by *Grandidierella megnae*, a species found also in the Ganges Delta, L. Chilka and Madagascar. The genus is known only from Madagascar, India, and now China, and the fact that the same species is found to inhabit the Ganges Delta and the Tai-Hu is almost if not completely paralleled among the Isopoda, for *Tachaea spongillicola* from the Ganges is remarkably close to, if not identical with *Tachaea chinensis* from China.

The northern element in the marine fauna of the Tai-hu is much more marked

This element may be regarded as a relict fauna and among the Amphipoda is represented by *Monoculodes limnophilus*, a representative of an almost exclusively Arctic genus, and one hitherto known from only strictly marine localities.

The marine element in the fauna of the Tai-Hu suggests a comparatively recent geological origin for this water-system.

The freshwater systems of Japan are of more remote origin and the crustacean fauna provides evidence of affinities with that of the Palaearctic region of Europe and Asia, with America and with Australasia, that is, with the older and more remote, both in time and space, freshwater faunas of the globe.

Among the Isopoda I have already called attention to the occurrence of *Asellus aquaticus* in L. Biwa, a Palaearctic species of wide distribution, and of *Caecidothea kawamurai*, a new species from a well in Otsu near Kyoto, whose nearest allies are found in caves and freshwater wells in America.

Among the Amphipoda there are corresponding relationships. In one of the inland mountain streams of Japan was discovered *Gammarus pulex*, a Palaearctic species with a distribution corresponding to that of *Asellus aquaticus*. This species was, however, absent from L. Biwa, its place being taken by a new species, *Gammarus annandalei*, allied to the freshwater species of the great inland waters of the Palaearctic region (such as the Caspian Sea and Lake Baikal), of America (especially to the species *G. ramellus*) and of Australia.

In one of the other mountain streams of Japan Dr. Annandale discovered a species of *Atyloides* which is very closely allied to two freshwater species of the genus found by Sayce in Victoria, Australia. This discovery provides among the Amphipoda, a precisely parallel case to that already known among the Macrura in the genus *Paratya* (= *Xiphocaridina*).

The results obtained by Dr. Annandale from the point of view of geographical distribution are thus of exceptional interest.

I desire to thank Dr. Annandale for giving me the opportunity of examining and reporting upon this interesting collection, and my wife for the drawings illustrating this report.

ISOPODA.

Tribe *FLABELLIFERA*.

Family ANTHURIDAE.

Genus **Cyathura**, Norm. and Stebb.

Cyathura carinata (Kröyer)?

[Pl. XVIII, figs. 1–9.]

Locality.—Tai-Hu, a little N.E. of Si Dong Ding, China, 2-xii-15, 3 metres, on a bottom of mud with a little decayed vegetation, one female, 10 mm.

Remarks.—The element of doubt in the identification of this specimen is due to the appearance of the telson. This is very short, not much more than half the length of the uropods and very much shorter than in any other member of the family known to me. But though the telson in this specimen is almost symmetrical, it is devoid of setae and has every appearance of having been injured at some period, and I regard it in this light. Otherwise the specimen is in very close agreement with the published descriptions and figures of *C. carinata*. In support of my identification I have given figures of some of the appendages of my specimen. They will be found to agree very closely with the figures given by Norman and Stebbing (1886) and Richardson (1905).

The flagellum of the first antenna (pl. XVIII, fig. 3) is composed of two joints with possibly a minute third. Norman and Stebbing give four joints, while Richardson on the other hand figures only one. The flagellum of the second antenna (pl. XVIII, fig. 4) is composed of a single joint and this agrees with the figures and statements of both the authors named above. The thoracic legs agree absolutely with the description of Norman and Stebbing even to the pectinated spine at the distal extremity of the palm. The powerful second thoracic legs (pl. XVIII, fig. 5) as well as the remainder of these limbs bear a small secondary nail on the inner margin of the finger.

I have been unable to find any satisfactory account of the pleopods in the species of this family. They would appear to form an admirable basis for classification. In the present specimen the inner branch of all the pleopods is branchial in structure and not natatory and is devoid of plumose or simple setae of any kind. It is in all cases opaque and narrower than the outer branchand in the case of the first pair (pl. XVIII, fig. 9) much smaller. Both inner and outer rami in all the pleopods are composed of a single joint. Norman and Stebbing do not describe or figure the pleopods of this species. Harger (1880), however, figures the first and second pleopods and they agree with my own observations. His description is as follows:— "The first pair of pleopods are composed on each side of a short, quadrate basal segment supporting two rami, of which the outer is, like the basal segment, of firm texture, and acts as an operculum; in shape it is semi-oval, with the inner margin nearly straight, and is ciliated distally, and along the outer margin. The inner ramus is much smaller than the outer, and of delicate texture, and in the natural position is covered and concealed by the outer ramus; it is slender, with nearly parallel sides, rounded at the tip, and not ciliated."

I have quoted this description in full because it agrees so well with what I have myself observed and because it represents the only account of the pleopods of this species which I have seen.

Other writers have said very little about the structure of the pleopods in this family. Sars (Crustacea of Norway, Vol. II, Isopoda) figures the first pleopod of *Calathura norvegica* as composed of single-jointed rami, the inner setose distally; while his figure of pleopod two shows the rami to be each two-jointed, the inner setose distally. The pleopods of *Leptanthura tenuis* appear to be of substantially the same form. In *Ptilanthura tenuis* the first pair of pleopods have the rami single-jointed, the inner setose distally, while in the second pair Harger describes the outer ramus as imperfectly articulated near the middle. In *Anthelura remipes* Barnard describes the second pair of pleopods in the female as having the rami obscurely two-jointed and the same would appear to be the case in *Leptanthura faurei*, Barnard.

It is evident that more observation is required on the form and structure of the pleopods in this family but as far as present information goes the genus *Cyathura* would appear to be distinguished by having both rami of all the pleopods single-jointed, the inner ramus in all cases branchial and without setae on its margins.

The occurrence of this species in the fresh waters of the Tai-Hu is of remarkable interest. It was originally described from Greenland and is quite a common form in the shallow waters on the East Coast of the United States. It is also of frequent occurrence in the brackish waters of the Baltic Sea. Gurney has recently recorded it from the rivers of East Norfolk, and notes that "it seems to be capable of living in water either fresh or brackish. At Oulton Broad, at the time of capture, the water was very salt, but on the three other occasions on which it has been met with the water in which it was living was practically fresh." In the Tai-Hu, the water according to Annandale, is quite fresh.

AMPHIPODA.

Family OEDICEROTIDAE.

Genus **Monoculodes**, Stimpson.

Monoculodes limnophilus, n. sp.

[Pl. XVIII, figs. 10–20.]

Localities.—China.

1. Whangpoo River, between Shanghai and Wusung, 5–7 metres, 10-xii-15, abundant.
2. From Walker Island, up Hsi Kon Bay, Tai-Hu, 2–3 metres, 5-xii-15, abundant on a bottom of hard mud with shells in patches: no weeds.
3. Walker Island, Tai-Hu, close in shore, 5-xii-15, three specimens on mud with small stones and some weed.
4. Tai-Hu, a little N.E. of Si Dong Ding, 3 metres, 2-xii-15, thirty-three specimens.
5. Off Mouth of Moo Too Creek, Tai-Hu, 3 metres, 2-xii-15, one specimen.
6. Tai-Hu, a little N.E. of Si Dong Ding, 3 metres, 2-xii-15, abundant. (TYPES.)

Description.—*Body* smooth and not carinated; ornamented by a series of black chromatophores scattered over the back and sides, and on the posterior segments of the thorax and the anterior segments of the pleon, arranged in a transverse band across the posterior part of the somites.

Head (pl. XVIII, fig. 10) produced into a moderately long, acute and curved rostrum which extends to the distal end of the first joint of the peduncle of the first antenna. The head is not narrowly produced behind the eyes as in *M. hanseni*, *M. kröyeri* and *M. longirostris*.

Eyes moderately large, contiguous, pigment black, a large mass of ramose black chromotophores situated dorsally over the eyes and almost masking them in dorsal view.

Side-plates of the thorax presenting no special features but much as in the remaining species of the genus; the first side-plate somewhat expanded; side-plates 1–4 fringed with setae on their lower margins and with a specially strong spiniform seta on the posterior margin where the second joint of the limb comes off. The first three segments of the pleon have the lower hinder corners rounded and are without spines or setae.

First antenna (pl. XVIII, fig. 11) about equal to or slightly longer than the peduncle of the second antenna, first joint of the peduncle about as long as the second but considerably stouter, third joint shorter than the second, flagellum shorter than the peduncle, composed of 9–10 joints. In the male the second and third joints of the peduncle are shorter and stouter than in the female and the flagellum is composed of about 12 joints but there is no special development of sensory hairs.

Second antenna (pl. XVIII, fig. 12) in the female about one and a half times as long as the first, last joint of the peduncle elongate and slender about one and a half times as long as the preceding joint, flagellum longer than the last joint of the peduncle and composed of about 11–12 joints. In the male the flagellum is composed of about 20 joints.

Mouth parts and first thoracic limbs (maxillipedes) as for the genus.

Second thoracic limbs (first gnathopods) (pl. XVIII, fig. 13) rather slender and elongate, second joint long and narrow, very nearly as long as the rest of the limb, third and fourth joints short, fifth joint with the carpal process very long and narrow extending to the margin of the palm of the hand, sixth joint long and oval in shape, at least three times as long as broad, palmar margin longer than the hind margin of the joint, from which it is defined by a slight angle armed with a small spine, palmar margin furnished with long setae.

Third thoracic limbs (second gnathopods) (pl. XVIII, fig. 14) longer and somewhat more slender than the second, second joint longer than the rest of the limb, carpal process of the fifth joint very long and narrow, reaching to the margin of the palm of the hand, sixth joint smaller than the corresponding joint on the second thoracic limbs, long and almost linear in form, about three times as long as broad, palm about as long as the hind margin of the joint, defined by a slight angle furnished with a spine, and armed with long setae.

Pl. XVIII, fig. 15 shows the form of the fifth pair of thoracic limbs. The fourth to the seventh pairs resemble this figure in general structure. In all the carpus is about equal to the propodus and the nail long and well developed and only slightly shorter than the propodus.

In the sixth and seventh pairs the second joint is furnished with long plumose setae.

Eighth thoracic limbs (pl. XVIII, fig. 16) very elongate, second joint somewhat pyriform in shape, posterior margin fringed with short setae and having the lower distal corner produced into a lobe as long as the third joint, which is quite short; fourth to the seventh joints long and successively narrower, the propodus slightly longer than the merus, carpus and dactylus, which are subequal in length.

Telson (pl. XVIII, fig. 17) entire, quadrangular in shape, almost parallel-sided, distal margin truncate or perhaps faintly emarginate and armed with two feeble spiniform setae.

Uropods (pl. XVIII, figs. 18–20) having the outer ramus shorter than the inner in the first two pairs and equal to the inner in the third pair. The peduncles successively shorter in each pair and furnished with a few spines. The rami each with two or three spines.

Length of the largest specimens, 6 mm.

Nineteen species of the genus *Monoculodes* are at present known. The present species is distinguished from them all by the structure of the second and third thoracic limbs. The second thoracic limb especially forms a good distinguishing character. The sixth joint is longer and more oval in shape, and the carpal process of the fifth joint much longer and narrower than in any other species of the genus. The second thoracic limb, moreover, approaches the form of the third thoracic limb more closely in this species than in any other known to me.

The occurrence of this typically arctic genus in fresh water in China is a matter of great surprise and interest. It is, moreover, the first record of any member of the family from waters other than strictly marine. Of the known species of the genus, one is known from the Gulf of Naples, one from deep water in the North Atlantic (Lat. 46° N.) and one from the American coast. The remaining species are distributed widely in the Arctic Ocean, some few extending to Norway and the Kattegat and to the British Isles.

[This is the common aquatic amphipod of the Tai-Hu system, taken in shallow water (3–7 metres) on a muddy bottom both in the lake and in the river, *N. A.*]

Family PONTOGENEIIDAE.

Genus **Atyloides**, Stebbing.

The new species described below is certainly congeneric with *Atyloides gabrieli*, Sayce, and *A. fontana*, Sayce, and for that reason I retain the generic name *Atyloides*. But I must confess that the validity of the genus is somewhat doubtful and I am not sure that a new genus ought not to be formed for the three freshwater species, leaving the marine forms to be distributed among one or other of the recognised genera in this family.

The genus was originally established by Stebbing in his report on the Challenger Amphipoda. No definite type species is indicated but the definition of the genus is immediately followed by descriptions of *A. australis* (Miers), *A. assimilis*, Stebbing, and *A. serraticauda*, Stebbing, in that order.

In 1906, Stebbing cancelled the first two species as synonyms of *Paramoera austrina* (Bate). It seems to me that *Atyloides* thus becomes a direct synonym of *Paramoera*. In 1901 and 1902 Sayce described two freshwater species from Victoria, Australia, *A. gabrieli*, and *A. fontana* and in 1906 these species with *A. serraticauda*, Stebbing, remained the only three species in the genus. Of these, the last named has been referred by Vanhöffen to the genus *Leptamphopus* in quite a separate family !

Since 1906 the following new species have been attributed to the genus: *A. brevicornis*, Chevreux, *A. longicornis*, Chevreux, *A. calceolata*, Chilton, and *A. aucklandicus*, Walker, while a fifth species, originally described by Stebbing as *Atylopsis magellanica* and transferred later by him to the genus *Pontogeneia*, was also referred to *Atyloides* by Chilton. Barnard (1916) has, however, shown that *A. magellanica* is the same species as *Pontogeneia capensis* (Dana) and is in reality a species of *Paramoera*.

The genus *Atyloides* therefore at the moment contains seven species. According to Stebbing (1906) the genus is distinguished from *Paramoera* only by having the first antenna longer than the second instead of shorter and both genera are distinguished from all the others in the family by having a small one-jointed accessory flagellum to the first antenna. Of the seven species still retained in *Atyloides*, *A. brevicornis* and *A. longicornis* have no accessory flagellum and in both species the second antenna is longer than the first. It is impossible from the published descriptions to define the condition in respect to these characters in *A. calceolata* and *A. aucklandicus*. So that only three species, *A. gabrieli*, *A. fontana* and *A. serraticauda* conform to the original generic definition.

Apart from the question as to whether *Atyloides* is not in reality a synonym of *Paramoera*, it will be seen that a good deal of confusion and uncertainty exists among the genera and species of this family. We may endorse Chilton's remarks that "in this family of Amphipods particularly there has been an unnecessary multiplication of genera, and consequently some characters have been introduced into the generic descriptions which are subject to individual variation."

Into this confusion it does not seem opportune to introduce new generic names. I have therefore referred the new species described below to the genus *Atyloides* because it seems to me to be clearly congeneric with *A. gabrieli* and *A. fontana* and possibly with *A. aucklandicus*, Chilton, 1909, which is doubtfully the same as *A. aucklandicus*, Walker.

Atyloides japonica, n. sp.

[Pl. XIX, figs. 13–19.]

Locality.—Small torrent in hills behind Komatsu on Lake Biwa, 28-x-15, two specimens, 7 mm.

Description.—*Body* smooth, without ridges, carinae or spines but with a few very short, scattered setae on the dorsal surface. First four coxal plates deeper than their respective segments, with a few short setae on their lower margins, first two not expanded distally, fourth not quite as broad as deep, excavated posteriorly. Third segment of the pleon having the posterior margin with 6–7 slight crenulations, a seta in each notch, lower posterior angle only very slightly produced, lower margin with three setae. Eyes large, at least half as deep as the head, reniform in shape, pigment black.

First antenna (pl. XIX, fig. 13) about half as long as the body, first joint of the peduncle slightly longer and stouter than the second, third joint about two-thirds of the length of the second, flagellum composed of about 40 joints, accessory flagellum minute, about one-fourh of the length of the first joint of the main flagellum and tipped by three setae.

Second antenna (pl. XIX, fig. 14) shorter than the first, with its peduncle equal in length to that of the first, fifth joint slightly shorter than fourth, both with two or three fascicles of short setae on the lower margin, flagellum of about 30 joints.

Mouth parts agreeing very closely with those of *A. fontana*, Sayce, except that there are only two triangular teeth on the distal margin of the inner plate of the maxillipedes. *A. japonica* agrees with *A. fontana* as against *A. gabrieli*, Sayce, in the less expanded form of the mandible palp and in having the inner lobe of the first maxilla furnished with 10 plumose setae.

Second and third thoracic limbs (first and second gnathopods) (pl. XIX, figs. 15–16) subequal in size and very similar in form, second joint with a few very long setae on its margin, carpus shorter than the propodus, hardly if at all lobed, with a few fascicles of setae on the inner edge, propodus oblong, subquadrate, nearly twice as long as broad, palm slightly oblique with a fringe of short setae and four or five spines on the outer corner, inner margin of the propodus with four or five bunches of setae, outer margin with a bunch of setae at the distal end and two or three other fascicles, finger equal to the palm. Second joint of the last thoracic limbs (pl. XIX, fig. 18) broadly oval, front margin with a few spines, hind margin regularly and finely serrate and produced beyond the third joint.

First uropods with the peduncles longer than the subequal rami. Peduncle with one spine on each of the upper distal corners. Inner ramus with two spines on the upper margin and two small and one large spine at the tip. Outer ramus with one spine on the upper margin and three at the tip.

Second uropods extending back to the level of the first uropods, peduncle longer than the rami, with one spine on the upper margin and one at each upper distal corner. Inner ramus slightly longer than the outer, both with two spines on the upper margin and three at the apex.

Third uropods (pl. XIX, fig. 19) outreaching the first and second by about half the length of their branches, peduncle shorter than the rami, with one spine on the inner margin and one at each upper distal corner. Rami equal in length, lanceolate, with 5–6 spines on their inner margins and 3–4 spines on their outer margins, a plumose seta accompanying each spine.

Telson (pl. XIX, fig. 19) at least as long as the peduncle of the third uropods, cleft almost to the base, each lobe furnished with four long setae in a row at the apex and a single long seta anterior and lateral to the terminal setae.

Length of both specimens, 7 mm.

Remarks.—This species is, I think, without doubt, congeneric with *A. gabrieli* and *A. fontana*, Sayce. It agrees specially closely with the latter species and is distinguished by the larger eyes of reniform shape, the relatively longer third uropods, the very many fewer spines on the first and second uropods, the armature of the telson, the form of the posterior margin of the third somite of the pleon, the less lobed form of the carpus of the gnathopods and the presence of only two triangular teeth, instead of three, on the distal margin of the inner lobe of the maxillipedes. It differs from *A. gabrieli* in these points and in addition in the number of setae on the inner lobe of the first maxilla and in the less expanded form of the second joint of the palp of the mandible.

All three species are freshwater and found in mountainous streams at good altitudes, Sayce's species in Victoria, Australia, the present species in Japan. It is a matter of great interest to note the curious distribution of these three species, which, however, finds its parallel among Crustacea in the genus *Paratya* among the Macrura. Whether the three species of *Atyloides* here dealt with are congeneric with the marine species referred to that genus is a point which I am unable to decide.

On the sternum of certain of the thoracic somites of both specimens I found a number of finger-like processes. As far as I can make out these processes are present on the third to the seventh somites and there may be one or two pairs, symmetrically arranged, on each somite. I am quite unable to suggest what these processes are or what their function may be, but they suggest the similar processes found by Sars in *Gammarus pulex* and *Pontoporeia affinis*, by Smith in *Pontoporeia hoyi* and by Shoemaker (1920) in *Synurella johanseni*.

It is probable, too, that the processes found by Chilton in *Gammarus barringtonensis* are of the same nature. They are quite distinct from the accessory branchial vesicles which I have described below in *G. annandalei*, which are definitely additional processes on the outside of the branchial lamellae themselves.

Family GAMMARIDAE.

Genus **Gammarus**, Fabricius.

Gammarus annandalei, n. sp.

[Pl. XX, figs. 1–18.]

Localities.—CHINA.

1. Off Si Dong Ding, Tai-Hu, 10-xii-15, ten specimens, 5–7 mm.
2. Outskirts of Shanghai, in ditches and small ponds, 17-ix-15, five specimens, 4–5 mm.

JAPAN.

Lake Biwa.

1. Station 5, off Komatsu, on west side of lake, 74 metres, firm mud, 1-x-15, twenty-one specimens.
2. Station 6, off Komatsu, nearer the shore than station 5, 53 metres, soft mud mixed with shells and small pebbles, 1-x-15, ten specimens.
3. Station 8, in the centre of the lake near White Rocks, 77 metres, mud with fragments of shell, about fifty specimens. (TYPES.)
4. Station 12, two specimens from a depth of 190–200 feet in Lake Biwa.
5. Station 13, shore at Chikubushima, on lower surface of stones, four young, 2-x-15.

6. Station 14, off Suga, on west side of lake, 52 metres, fine grey mud, 2-x-15, eight specimens.
7. Station 15, West Coast of Oura Bay, at north end of lake, 17–31 metres, sand mixed with mud, 2-x-15, ten specimens.
8. Station 22, Hikone Fishery Station near the east side of the lake, in irrigation channels among weeds, about fifty specimens.
9. Off Komatsu, 30 feet, fine gravel, seven specimens.
10. Off Komatsu, in the interior of *Spongilla clementis*, five young specimens.
11. Zézé, on lower surface of stones on shore, 3-x-15, about forty specimens.

Northern Japan.

12. Sapporo, Hokkaido (Yezo), April 1915, e. coll. Akatsuka, about forty specimens. (Presented by Dr. T. Kawamura.)

Description.—First three somites of the pleon with a fringe of 10–12 short fine hairs on the median dorsal portion of the posterior margin, their lower margins with three or four spiniform setae and a few hairs on the anterior portion, postero-lateral corner acute and slightly produced. Pl. XX, fig. 14 shows the lower margin of the third pleon somite in one of the specimens and gives the essential structure of these somites in this species. The fourth to the sixth pleon somites (pl. XX, fig. 18) are armed with spines on the dorsal surface. On the fourth and fifth somites there are two pairs of dorsal spines and a few short setae, on the sixth pleon somite there is only one pair of spines, one on each side. There is considerable variation in the number of spines on these somites and the figure I give showing their arrangement must be taken as the average typical armature.

Head not rostrate, antero-lateral angles rounded.

Eyes moderate in size, broadly oval, almost circular in outline, pigment black.

Side-plate 4 (pl. XX, fig. 11) with the posterior angle distinct but obtuse and the margin above slightly concave.

First antenna (pl. XX, fig. 1) not half the length of the body, second joint of the peduncle as long as the first but narrower, third joint of the peduncle rather more than half as long as the second, primary flagellum with about 20 joints, accessory flagellum with 5 joints, the terminal joint minute. The whole appendage is but sparingly provided with setae.

Second antenna (pl. XX, fig. 2) about $\frac{2}{3}$–$\frac{3}{4}$ of the length of the first, the peduncle reaching beyond the level of the peduncle of the first antenna. There is variation in this character. In some specimens the peduncle of the second antenna outreaches that of the first by half the last peduncular joint and in other specimens the difference is much less. The last joint of the peduncle is shorter than the fourth and the flagellum is composed of about 12 joints. The males have a few calceoli on the flagellum joints. *Mouth parts* are normal for the genus *Gammarus*. *The first maxilla* has the inner lobe moderately broad with about 18 plumose setae on the inner margin and 6 or 7 simple setae on the distal part of the outer margin.

The second thoracic limbs (first gnathopods) of the female (pl. XX, fig. 6) with the propodus rather larger than the carpus, somewhat dilated, palmar margin oblique and armed with a few simple spines. In the male (pl. XX, fig. 3) these appendages have the propodus larger and more robust than in the female, more quadrangular in shape, palmar margin more transverse and armed with a number of stout peculiarly striated blunt spines (pl. XX, fig. 5).

Third thoracic limbs (second gnathopods) in the female (pl. XX, fig. 7) longer than the first, propodus as long as the carpus, rectangular in shape, twice as long as broad, armed with numerous tufts of setae, palmar margin almost transverse. In the male (pl. XX, fig. 4) these appendages have the propodus rather stouter than in the female, the palmar margin armed with stout blunt spines similar to those on the first gnathopod of the female.

The form of the remaining thoracic limbs may be seen from pl. XX, figs. 8–9, representing the fourth and eighth thoracic limbs. The last three pairs of thoracic limbs are characterized by the rather narrow pyriform shape of the second joint, which, in the eighth pair, is nearly twice as long as broad.

The branchial lamellae of the third to the eighth thoracic limbs have accessory branchiae in the form of long cylindrical finger-like processes arising at the base of the main lamella on the outside of the peduncle. These accessory branchial processes are shorter on the last thoracic somite than on the others and may be two in number on some of the gills (pl. XX, fig. 10).

Third uropods of similar form in both sexes, but in the male (pl. XX, fig. 17) considerably larger than in the female and extending well behind the first and second pairs. In the female the third uropods only extend slightly beyond the first and second pairs. In the male the peduncle is short, about $\frac{1}{5}$ of the length of the outer branch. Inner branch slightly shorter than the peduncle and $\frac{1}{6}$ of the length of the outer branch. Latter two-jointed with the second joint $\frac{1}{8}$ of the length of the first, with groups of spines along both margins but only a few setae.

Telson (pl. XX, fig. 18) cleft almost to the base, lobes dehiscent with their apices rounded and armed with one spine and one or two setae. Lateral margins with one or two (in one case three) spines.

Length of males and females, 15 mm.

The description given above applies to those specimens captured in the deeper part of L. Biwa, from 20–77 metres, i.e. Stations 5, 6, 8, 12, 14 and 15 in the above list, and I have selected these as the types of the species. I have referred all the Gammarids captured in L. Biwa to the same species but a few notes on variation may be useful.

The specimens from Sapporo differed from those in L. Biwa in having more numerous spinules on the pleon somites and in having more setae on the telson and a development of setae on the inner margin of the outer ramus of the third uropods. An adult male from Sapporo, quite as large as any from L. Biwa, had one pair of spinules on the second pleon segment, two pairs on the third segment, three pairs on the fourth and fifth segments and five spinules on the sixth segment. Each lobe of the telson had two prominent spines and five or six setae while the inner margin of the outer ramus of the third uropods bore about fifteen long plumose setae. The remaining specimens from this locality had the pleon segments similarly armed with spinules but occasionally the pair on the second pleon segment and one of the pairs on the third pleon segment were absent. The setae on the uropods were only found on adult males. In other characters the specimens were in substantial agreement with the specimens from L. Biwa. All had accessory branchial vesicles on the branchial lamellae.

The specimens from St. 13 are quite small and immature. The pleon segments have the following arrangements of spinules commencing with somite: 1, 0 prs, 2 prs, 4 prs, 3 prs, 3 prs, 2 prs. There are thus many more spinules on the pleon than in the typical form. Moreover, there is a greater development of setae on the antennules and antennae. But both these characters appear to become less pronounced with age. The setae on the antennules and antennae become fewer and the spinules on the pleon reduced in number.

The specimens from Komatsu, from the interior of *Spongilla clementis*, are also young specimens. The number of pairs of spinules on the pleon segments is 0, 1, 1, 2, 2, 1. These specimens are therefore less spinulose than those from St. 13, but in having spinules on the second and third segments of the pleon they show a divergence from type.

The specimens obtained in 30 feet of water off Komatsu are seven in number and include a typical male of *G annandalei*, 11 mm. in length and agreeing with the type in the spinulation of the pleon. The smaller specimens from 4–8 mm. in length have more spinules on the pleon and in four of them there are spinules on the second and third segments.

It will be seen therefore that there is considerable variation in the specimens in two characters :—

(1) The number and arrangements of spinules on the segments of the pleon.

(2) The development of setae on the antennules, antennae, telson and uropods.

This variation is of two kinds :—

(*a*) Variation with age. In the L. Biwa specimens there is definite evidence that young specimens have more spinules on the segments of the pleon and a greater development of setae on the antennae and antennules.

(*b*) Variation of specimens of approximately equal age from different localities. The Sapporo specimens have a greater number of spinules on the segments of the pleon, more setae on the telson and, in adult males, a development of setae on the inner margin of the outer branch of the third uropods.

But similar types and degrees of variation are known in *Gammarus pulex* and there seems no reason to regard it as of specific importance in the present cases.

In his synopsis of the Amphipoda Gammaridea, Stebbing (1906) gives a key to thirty species of the genus *Gammarus* and an additional species (*G. tunitanus*, Simon) is regarded as doubtful. In the appendix to this valuable work a further seven species of the genus are listed, and, since its publication, as far as I can make out, sixteen new species have been referred to the genus which now comprises fifty-four species.

It is as well, perhaps, to indicate the relationship of the new species here described by reference to Stebbing's key and for that purpose I give below a list of all the species of *Gammarus* not included in that key with an indication of their approximate position as far as can be judged from the published description.

Species.	*Position in Stebbing's Key.*
G. caecus, Weckel, 1907. *G. haasei*, Sayce, 1902.	Distinguished at once from all other species by the absence of eyes.
G. tetrachantus, Garbini, 1902.	Distinguished from all the other species by having the last thoracic and first three abdominal somites produced dorsally into a median process. I should very much doubt if it is correctly referred to *Gammarus*.
G. capensis, Barnard, 1916. *G. nigroculus*, Barnard, 1916. *G. crassicornis*, Barnard, 1916. *G. auricularis*, Barnard, 1916. *G. barringtonensis*, Chilton, 1916.	Excluded in Stebbing's key under heading 7 and therefore allied to *G. obesus*, Sars.
G. australis, Sayce, 1901.	Excluded in Stebbing's key under heading 13 and therefore allied to *G. weidemanni*, G. O. Sars, and *G. maeoticus*, Sowinsky.
G. ramellus, Weckel, 1907. *G. sowinskii*, Behning, 1914.	Excluded in Stebbing's key under heading 22 and therefore allied to *G. pungens*, M.-Ed.
G. chevreuxi, Sexton, 1913.	Excluded in Stebbing's key under heading 24 and therefore allied to *G. duebenii*, Lillj.
G. limnaeus, S. I. Smith, 1874.	Excluded in Stebbing's key under heading 26 and therefore allied to *G. pulex*, Linn.
G. zaddachi, Sexton, 1912. *G. pribilofensis*, Pearse, 1913.	Excluded in Stebbing's key under heading 29 and therefore allied to *G. locusta*, Linn.

Owing to deficiencies in the published descriptions and figures I am unable to place the following species in their proper place in Stebbing's key :—

G. sarsii, Sowinsky, 1898.
G. ripensis, G. Smith, 1909.
G. antipodeus, G. Smith, 1909.
G. breweri, Kunkel, 1910.
G. purpurascens, W. P. Hay, 1902.
G. propinquus, W. P. Hay, 1902.

Of these six species, the first three have the inner ramus of the third uropods very short and are comparable in this respect to *G. annandalei*. But the descriptions and figures are wanting in respect to the armature of the last three segments of the pleon.

The only specimen of *G. breweri* as yet collected had lost the third uropod and the published description gives no information as to the armature of the pleon.

In *G. purpurascens* and *G. propinquus* the inner branch of the third uropod is at least half as long as the outer and thus both species are very distinct from *G. annandalei*.

I have not been able to consult the descriptions of *G. polymorphus*, Helfer, 1914, and *G. argaeus*, Vavra, 1906. With this brief review of the known species of the genus it is possible to state shortly the affinities of *G. annandalei*. With the aid of Stebbing's key it is excluded under heading 22, and is thus related to *G. pungens*, M.-Ed., *G. ramellus*, Weckel and *G. sowinskii*, Behning. From these three species it is distinguished by the shorter first and second antennae, by the form of the second and third thoracic limbs in both sexes and by the third uropods which have the inner ramus comparatively longer than any of the above three species. It is, however, as well to point out that *G. ramellus* has the palm of the second and third thoracic limbs armed with the same type of peculiar spine as in *G. annandalei*. But *G. annandalei* differs from all the species of the genus, in the possession of accessory vesicles on the branchial lamellae. Chilton (1916) in describing *G. barringtonensis* notes that "on some of the segments of the peraeon" there are finger-like appendages which appear to be of the same nature as the 'single accessory branchiae' described in *Hyalella jelskii*, Wrzesn., and *H. dybowskii*, Wrzesn.". Chilton further says that these appendages appear to arise from the sternum of the segment internal to the branchiae, but he was unable to determine their exact occurrence. The processes seen by Chilton must be, I think, of the same nature as those I have noted above in *Atyloides japonica* and those seen by other authors in species of *Gammarus*, *Pontoporeia*, and *Synurella*. They are quite distinct from the accessory branchial processes of *G. annandalei* which are attached distinctly to the *outside* of the branchial lamellae. In no other species of *Gammarus* have I been able to find any mention of accessory branchial vesicles though they are found in the genus *Hyalella* and in some of the Lysianassidae.

It is to be regretted that Smith's inadequate descriptions of *G. ripensis* and *G. antipodeus* do not permit of a closer comparison of these species with *G. annandalei*. They agree with the latter in the short inner ramus to the third uropods but Smith makes no mention of the armature of the pleon or of the structure of the branchial lamellae and it is not possible to say how nearly allied to *G. annandalei* they really are. This is unfortunate because Smith regards these two species as in a measure intermediate in structure between the genera *Gammarus* and *Neoniphargus* and he suggests that the latter genus has been derived from the former in the Southern hemisphere and is not genetically related to the genus *Niphargus* of the Northern hemisphere, the resemblance between *Niphargus* and *Neoniphargus* being regarded as a remarkable case of convergence.

G. annandalei is a true *Gammarus* in all the characters that are supposed to distinguish that genus from *Neoniphargus*. The first maxillae are of the true *Gammarus* type and not of the intermediate form found in Smith's two species.

It would be interesting to be able to define more accurately the relationship of *G. annandalei* to the Australian and Tasmanian species in view of the occurrence of the genus *Atyloides* in Japan and Australia and the parallel case of *Paratya* among the Macrura.

[This is the common aquatic Amphipod of Lake Biwa. It is abundant on a muddy bottom in from 50 to 77 metres and occurs more sparingly in shallower water. It is also found, both in China and Japan, in ditches and similar situations. The young apparently conceal themselves more carefully than the adults and their occurrence in the patent exhalent channels of a sponge (*Spongilla clementis*) is noteworthy. *N. A.*]

Gammarus pulex (Linn.).

[Pl. XX, figs. 19–27.]

Locality.—Hills above Otsu, L. Biwa, among moss and gravel in small streamlet in wood, forty specimens, up to 11 mm. in length.

Remarks.—I cannot find any characters of specific importance in which these specimens differ from typical *Gammarus pulex.*

Chevreux (1907) has noted the most important points in which specimens of this species from different localities vary and it will be as well to describe the characters of the Japanese specimens in these respects.

1. *The form of the lower posterior angle of the third pleon segment.*—Pl. XX fig. 25 shows the form of this plate in my specimens. The lower posterior angle is slightly produced and bluntly pointed. There are three or four short setae on the posterior border and one stronger seta on the lower border.

2. *The spinulation of the last three segments of the pleon.*—On the fourth and fifth somites of the pleon there is a pair of dorsal spines, with a pair of fine short setae between them and a pair of setae to the outside of each spine. There do not appear to be any lateral spines on these segments. On the sixth somite of the pleon there is a lateral spine (sometimes two), on each side of which there is a pair of setae. There is no dorsal pair of spines but the dorsal pair of setae is present.

3. *The accessory flagellum of the first antenna.*—The specimens show considerable variation in the number of joints in this accessory appendage, from three joints of more or less equal size to five joints, four of which are subequal and the terminal joint very small.

4. *Armature of the telson.*—Pl. XX, fig. 27 depicts the telson of a male specimen, 11 mm. Each lobe has two spines and four or five setae at the apex and a few setae on the lateral margins.

5. *The proportions of the rami of the third uropods* (pl. XX, fig. 26).—The internal ramus is about three-quarters of the length of the first joint of the outer ramus. I figure in addition the second and third thoracic limbs (first and second gnathopods) of both male (pl. XX, figs. 21–22) and female (pl. XX, figs. 19–20), the last thoracic limb of the male (pl. XX, fig. 23) and the fourth coxal plate (pl. XX, fig. 24). I

was not able to detect any calceoli on the first antenna of the male. The branchial lamellae are simple, without accessory vesicles.

Distribution.—This is the first record of the species from Japan but its occurrence there is not unexpected. Its distribution can now be traced right across the Palaearctic region from the British Isles to Japan.

Family TALITRIDAE.

Genus **Talorchestia**, Dana.

Talorchestia japonica, n. sp.

[Pl. XXI, figs. 1–10.]

Locality.—Among damp weeds on the shore of Lake Biwa at Zézé, 3-x-15, thirty specimens up to 9 mm. in length.

Description.—*Body* smooth without ridges or carinae, or armature of spinules or setae; preserved specimens show extensive traces of a rose-coloured pigment on the thoracic and abdominal somites in bands across the dorsal surface, most pronounced on the last three thoracic and first three abdominal somites; first and second antennae also tinged rose colour.

Eyes moderately large, separated dorsally by a distance less than their greatest diameter, pigment black.

Side-plates one to four with a few small setae on their lower margins, second to fourth with a prominent lobe on the hind margin about the centre; third segment of the pleon (pl. XXI, fig. 6) with its lower posterior corner slightly produced and its hind margin with four or five minute serrations, each serration armed with a small spinule.

First antenna equal in length to the first four joints of the peduncle of the second pair; three joints of the peduncle subequal in length, each furnished with a single spine on its upper distal corner, the second and third joints with one or two spines at their lower distal corners; flagellum of 4–5 joints.

Second antenna with the fifth joint of the peduncle equal in length to the preceding four joints but narrower; third joint with a group of seven spines on the lower distal corner, two on the upper distal corner and two or three scattered over the surface; fourth joint with three groups of two spines on the lower border, one spine at the upper distal corner, one on the outer margin and five or six scattered over the surface; fifth joint with 9–10 spines on the upper margin and three or four on the distal part of the lower margin; flagellum slightly longer than the peduncle and composed of 11–14 joints.

Second thoracic limbs of the male (pl. XXI, fig. 3) with the side-plate widening slightly distally, its lower margin provided with four or five setae; no pellucid lobe on the merus; carpus about equal to the propodus with a prominent rounded pellucid lobe on the hind margin towards the distal end; propodus widening distally to the usual lobe on its hinder margin, a row of setae marking the junction of the lobe with the joint proper; dactylus shorter than the palm formed by the wider end of the propodus; setae on the limb few and short.

Third thoracic limb of the male (pl. XXI, fig. 4) with the side-plate furnished with about a dozen small setae on its lower margin and a prominent lobe on its hinder margin; propodus broadly oval, the anterior margin convex and without setae except for two small ones at the base of the finger, posterior margin very convex, about half of it occupied by the palm which consists of a shallow groove flanked on each side by a row of 17–18 spinules and ending in a small pocket into which the nail fits; nail long and curved with a number of minute setae on its inner margin; setae on the limb very small and few.

Second thoracic limb of the female (pl. XXI, fig. 1) of the usual form, propodus slightly shorter than the carpus, its inner margin furnished with strong spiniform setae and with just a suggestion of a palm at its distal end.

Third thoracic limb of the female (pl. XXI, fig. 2) with the second joint wider proximally than distally, merus with a small pellucid lobe, carpus slightly longer than the propodus, each of these joints with the usual rounded lobes, that on the propodus extending well beyond the short oblique palm; setae on the limb few and small.

Sixth to eighth thoracic limbs (pl. XXI, fig. 5) having the front margins of the second joints armed with 8–10 spinules and the hind margins of the same joints with about 12 small serrulations, spinules between the teeth.

First uropods (pl. XXI, fig. 7) with the peduncle longer than the rami; peduncle with four or five spines on each of the upper and outer margins; inner branch with four spines on the upper margin and two large and two small spines at the apex; outer branch with no spines on its margins and two large spines at its apex.

Second uropods (pl. XXI, fig. 8) peduncle about equal to the branches; peduncle with two or three spines on each of the upper and outer margins; inner branch with two spines on the upper margin and three at the apex; outer branch with two spines on the upper margin and two strong spines and a small spinule at the apex.

Third uropods (pl. XXI, fig. 9) with the proximal joint bigger and broader than the distal joint, with two spines on the upper distal corner; distal joint with two small spines on the upper margin and one large and two or three small spines at the apex.

Telson (pl. XXI, fig. 10) slightly notched with three or four spines of various sizes at the apex of each lobe and two strong spines on each lateral margin.

Length of adult males and females, 9 mm.

Remarks.—Four of the specimens have the pigment of the eyes imperfectly developed and irregularly arranged. Chilton has called attention to similar specimens of *Talorchestia parvispinosa.*

Talorchestia malayensis, n. sp.

[Pl. XXI, figs. 11–20.]

Locality.—Botanical Gardens, Singapore, among dead leaves on ground in the shade of trees, on damp walls of drain and on damp earth under logs, 26-30-xii-15 3 males, 11 females.

Description.—This species is very closely allied to *T. japonica* and is best described by reference to the figures given herewith and by pointing out the differences between the two forms.

T. malayensis differs from *T. japonica* in the following points :—

(1) absence of serrulations on the hind margin of the third segment of the pleon (pl. XXI, fig. 16) ;

(2) there are only three joints in the flagellum of the first antenna ;

(3) the second thoracic limb of the female (pl. XXI, fig. 11) has no trace of a palm and is therefore strictly simple in type ;

(4) the presence of a distinct lobe on the merus of the second thoracic limbs of the male and the more pronounced lobe on the carpus of the same limb (pl. XXI, fig. 13) ;

(5) the shorter and broader hand of the third thoracic limb of the male ;

(6) the hind margin of the second joint of the last thoracic limb (pl. XXI, fig. 15) is minutely serrated throughout, the serrations much more numerous than in *T. japonica.*

Small differences in the proportions and armature of the limbs, telson and uropods can be detected by a comparison of the figures given for the two species [pl. XXI, figs. 11–20].

Length of the largest male, 7 mm., of the largest female, 9 mm. [This is the most completely terrestrial Amphipod with which I am acquainted. It is found in damp places at considerable distances from water. *N. A.*]

Remarks.—Stebbing (1906) refers nineteen accepted and two doubtful species to the genus *Talorchestia*. Since that date I have described one new species, *T. kempii*, and referred *Orchestia parvispinosa*, Weber, to this genus and Barnard (1916) has described three new species from South Africa, *T. quadrispinosa*, *T. ancheidos* and *T. australis* and transferred *Orchestia capensis* to the genus *Talorchestia*. The latter, therefore, now includes twenty-five accepted and two doubtful species.

By the use of the key to the species provided by Stebbing we find a group of very closely allied forms at the end of the key grouped under the headings 17 and 18. These species are *T. brito*, Stebb., *T. novaehollandiae*, Stebb., *T. martensii*, Weber, *T. kempii*, W.M.T., *T. parvispinosa*, Weber, *T. ancheidos*, Barnard, and *T. australis*, Barnard, to which must now be added the two species described above.

These nine species are very closely related to one another but may be separated, partially at any rate, in the following manner :—

I. Side-plates 2–4 ***without*** a well-marked lobe or tooth on the hinder posterior border .. .. *T. ancheidos*, Barn.

II. Side-plates 2-4 ***with*** a well-marked lobe or tooth on the hinder posterior boder.

(*a*) Second thoracic limb (first gnathopod) of the male *without* a meral lobe.

(1) Hind margin of the third pleon segment with a few small serrations .. .. *T. japonica*, W.M.T.

(2) Hind margin of the third pleon segment smooth, without serrations .. .. *T. brito*, Stebbing.
T. australis, Barn.
T. novae-hollandiae, Stebb.
T. martensii, Weber

(*b*) Second thoracic limb (first gnathopod) of the male *with* a meral lobe.

(1) Serrations on the hind margin of the second joint of the last thoracic limb few (about 10–12) and distant .. *T. parvispinosa*, Weber.
T. kempii, W.M.T.

(2) Serrations on the hind margin of the second joint of the last thoracic limb very numerous and closely set .. *T. malayensis*, W.M.T.

This table will indicate the relationships of the two new species described in this report and the characters by which they may be distinguished from their allies.

Talorchestia, sp.

Locality.—Si Dong Ding, Tai-Hu, China, under vegetable debris on shore, one female.

Remarks.—This specimen does not appear to show any appreciable differences from females of *T. japonica*, described earlier in this paper, but in the absence of male specimens I prefer not to give it a name.

Family AORIDAE.

Genus **Grandidierella**, Coutière, 1904.

Grandidierella megnae (Giles).

[Pl. XIX, figs. 1–12.]

G. Bonnieri, Stebbing, 1908
G. megnae, Chilton, 1921 (with synonymy).

Localities.—Whangpoo River, between Shanghai and Wusung, 5–7 metres, 10-xii-15, twenty-two specimens.

Whangpoo River, *ca.* 10 mi. below Shanghai, 5–7 metres, 10-xii-15, one specimen.

Walker Island, Tai-Hu, China, close inshore, 5-xii-15, three specimens.

Tai-hu, a little N.E. of Si Dong Ding, China, 3 metres, 2-xii-15, nine specimens.

Off Si Dong Ding, China, 2½ metres, 2-xii-15, nine specimens.

Remarks.—The following points of differences are to be noted between the Chinese specimens and the Indian specimens described by Stebbing:—

1. In Indian specimens the second joint of the peduncle of the first antenna is equal in length to the first and three times as long as the third.

   In Chinese specimens the second joint of the peduncle of the first antenna (pl. XIX, fig. 1) is one-third longer than the first and twice as long as the third in the male and one-quarter as long as the first and two and a half times as long as the third in the female.

2. The second joint of the second thoracic limb (first gnathopod) of the male (pl. XIX, fig. 5) is stouter in the Chinese than in the Indian specimens.

3. The fifth joint of the fourth and fifth thoracic limbs (first and second peraeopods) (pl. XIX, fig. 7) is only slightly longer than broad in Indian specimens and nearly twice as long as broad in those from China.

These differences are very small compared with the very close resemblance between the Indian and Chinese specimens in other characters. I have given detailed figures of the Chinese forms to support my identification and to compare with the figures given by Stebbing for the Indian examples.

I do not consider the differences I have pointed out are of specific importance. The Chinese examples are somewhat larger than those from India, 6 mm. for both sexes as against 4 mm. for the male and 5 mm. for the female.

The agreement between my specimens and Stebbing's description extends to the details of the mouth parts and the armature of all the appendages. The accessory appendage of the first antenna is shorter than the first joint of the flagellum and is tipped by a few setae. The flagellum of the first antenna has eighteen joints in both sexes and that of the second antenna six joints in both sexes.

Distribution.—This species is only known from brackish pools, Port Canning, Lower Bengal, and from the localities in China enumerated above. The distribution of the genus is quite remarkable. The type species, *G. mahafalensis*, Coutière, was found in an inland lake (water saline) in Madagascar, so that the genus now occurs in three isolated localities, Madagascar, Bengal and China.

(Since the manuscript of this paper left my hands, the important paper by Professor Chilton (1921) on the Amphipoda of Chilka Lake has been published. In this paper Chilton has identified *Grandidierella bonnieri*, Stebbing. with the earlier *Microdeutopus megnae*, Giles. I had overlooked Giles' species but I accept Chilton's identification and, while leaving the main body of my manuscript as it was written, I have altered the name of the species to read *Grandidierella megnae* (Giles). In the light of Chilton's description and figures practically all the small differences noted between Chinese and Indian specimens disappear and the identity of the Indian and Chinese forms is confirmed. Chilton goes further and identifies the original species of Coutière, *G. mahafalensis*, with Giles' species, so that the same species occurs in Madagascar, India and China. All my male specimens belong to Chilton's form I. Chilton places the genus in the family Aoridae and describes a second species, *G. gilesi*. W.M.T. September, 1921).

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EXPLANATION OF PLATES.

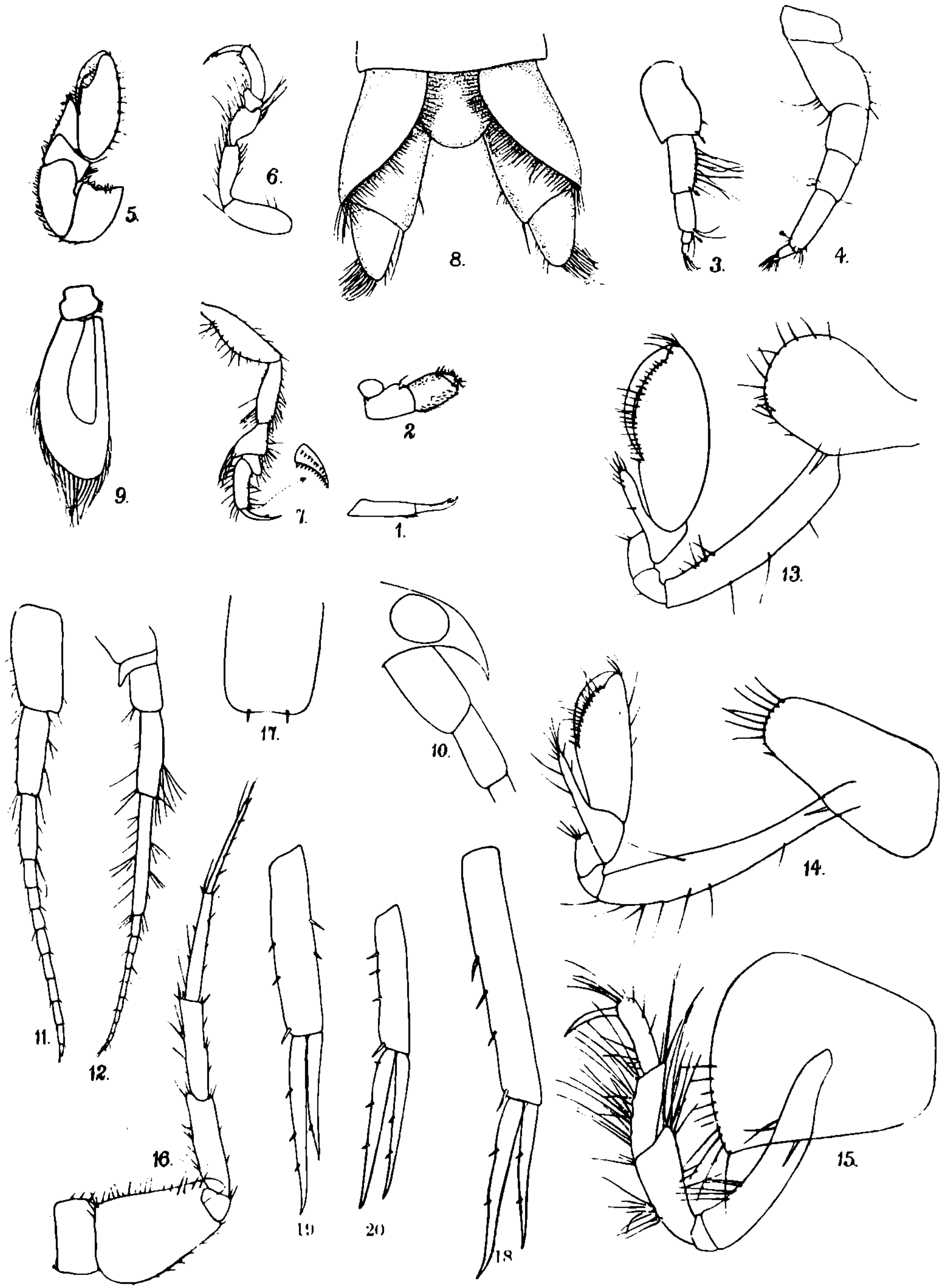
PLATE XVIII.

Cyathura carinata (Kröyer).

FIG. 1.—First maxilla. × 34·3.
,, 2.—Maxillipods. × 34·3.
,, 3.—First antenna. × 22·7.
,, 4.—Second ,, × 22·7.
,, 5.—Second thoracic leg. × 22 7.
,, 6.—Third ,, ,, × 22·7.
,, 7.—Eighth ,, ,, × 22·7.
,, 8.—Telson and uropods. × 22·7.
,, 9.—First pleopod. × 22·7.

Monoculodes limnophilus, n. sp.

FIG. 10.—Head and rostrum. × 24.
,, 11.—First antenna. × 44·6.
,, 12.—Second ,, × 34·3.
,, 13.—Second thoracic leg. × 44·6.
,, 14.—Third ,, ,, × 44·6.
,, 15.—Fifth ,, ,, × 44·6.
,, 16.—Eighth ,, ,, × 22·7.
,, 17.—Telson. × 68·7.
,, 18.—First uropod. × 44·6.
,, 19.—Second ,, × 44·6.
,, 20.—Third ,, × 44·6.



Figs. 1—9. Cyathura carinata (Kroyer).
Figs. 10—20 Monoculodes limnophilus, sp. nov.

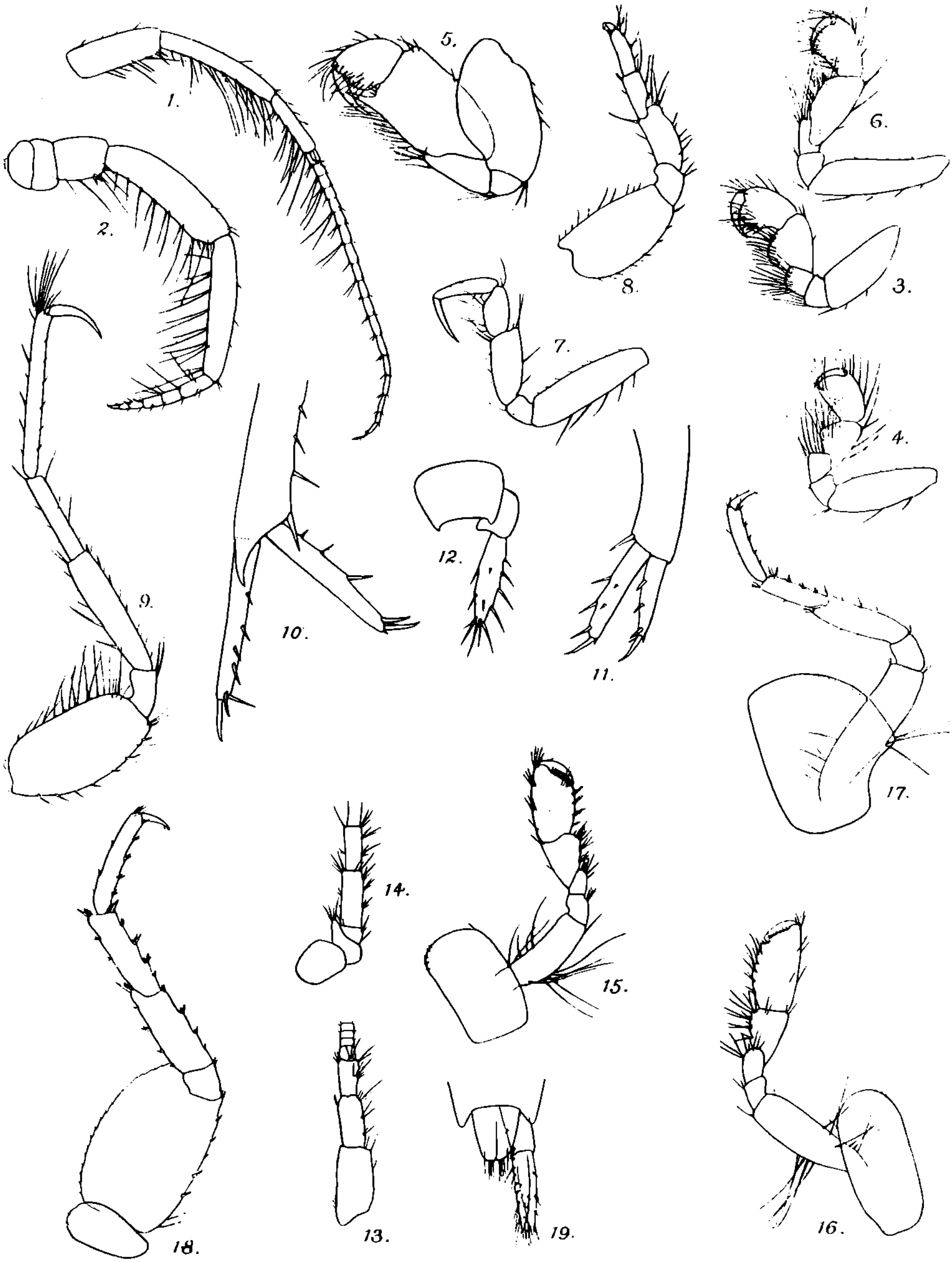
PLATE XIX.

Grandidierella megnae (Giles).

FIG. 1.—First antenna of male. × 22·7.
,, 2.—Second ,, ,, ,, × 22·7.
,, 3.—Second thoracic leg of female. × 22·7.
,, 4.—Third ,, ,, ,, ,, × 22·7.
,, 5.—Second ,, ,, ,, male × 22·7.
,, 6.—Third ,, ,, ,, ,, × 22·7.
,, 7.—Fifth ,, ,, ,, ,, × 22·7.
,, 8.—Sixth ,, ,, ,, ,, × 22·7.
,, 9.—Eighth ,, ,, ,, ,, × 22·7.
FIG. 10.—First uropod. × 44·6.
,, 11.—Second ,, × 44·6.
,, 12.—Third uropod and telson. × 44·6.

Atyloides japonica, n. sp.

FIG. 13.—Peduncle of first antenna and accessory appendage. × 22·7.
,, 14.—Peduncle of second antenna. × 22·7.
,, 15.—Second thoracic leg. × 22·7.
,, 16.—Third ,, ,, × 22·7.
,, 17.—Fifth thoracic leg. × 22·7.
,, 18.—Eighth ,, ,, × 22·7.
,, 19.—Third uropods and telson. × 22·7.



O. S. T. del.

Figs. 1—12. Grandidierella megnae (Giles).
Figs. 13—19. Atyloides japonica, sp. nov.

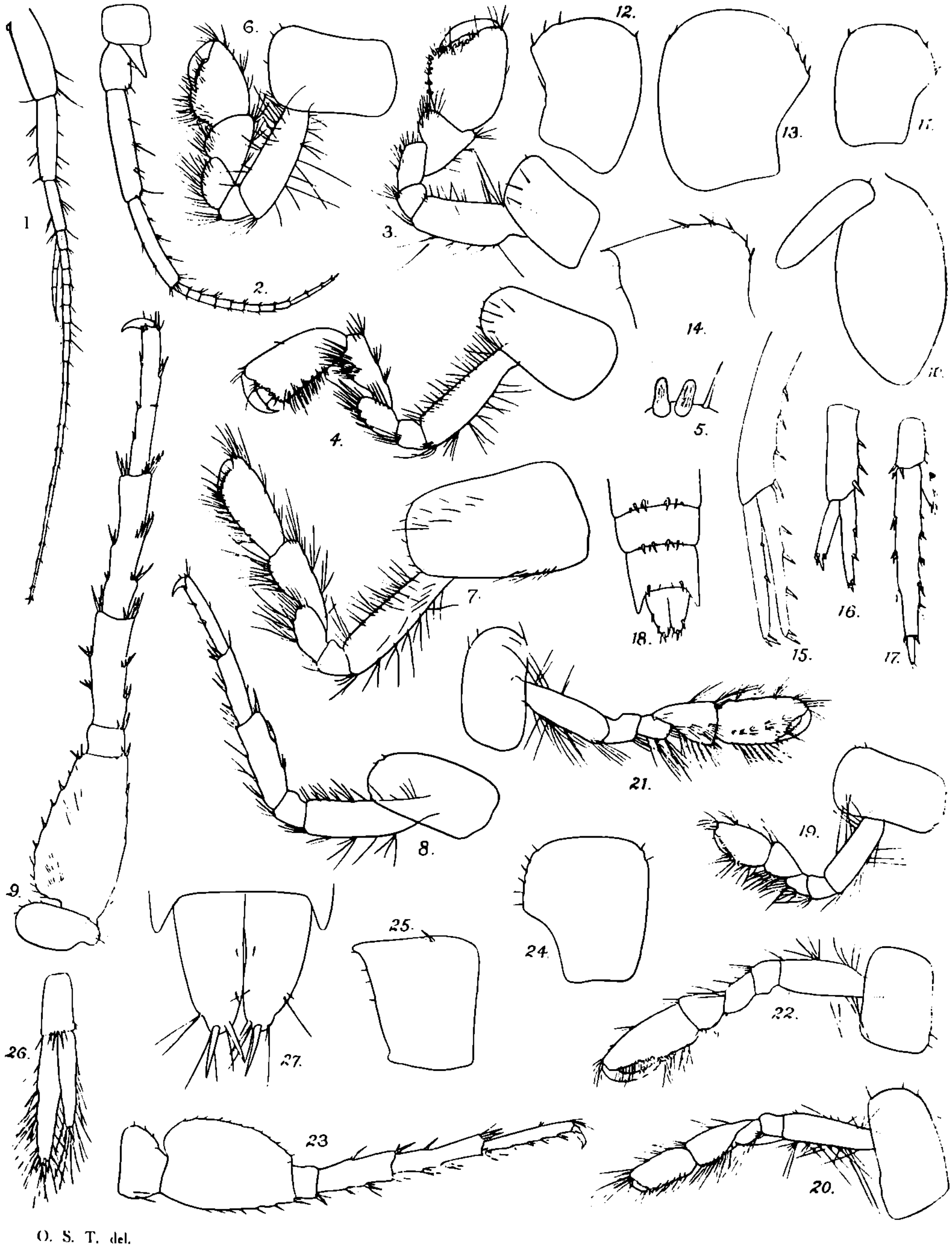
PLATE XX.

Gammarus annandalei, n. sp.

FIG. 1.—First antenna. × 15·1.
,, 2.—Second ,, × 15·1.
,, 3.—Second thoracic limb of male. × 15·1.
,, 4.—Third ,, ,, ,, ,, × 15·1.
,, 5.—Spines on palm of second and third thoracic legs of male. × 82·4.
,, 6.—Second thoracic limb of female. × 15·1.
,, 7.—Third ,, ,, ,, ,, × 15·1.
,, 8.—Fourth ,, ,, ,, male. × 15·1.
,, 9.—Eighth ,, ,, ,, ,, × 15·1.
,, 10.—Gill with accessory vesicle. × 15·1.
,, 11.—Fourth coxal plate of specimen from L. Biwa. × 15·1.
,, 12. ,, ,, ,, ,, ,, ,, Hikoné. × 15·1.
,, 13. ,, ,, ,, ,, ,, ,, Sapporo. × 15·1.
,, 14.—Lower margin of third pleon segments.
,, 15.—First uropods. × 15·1.
,, 16.—Second ,, × 15·1.
,, 17.—Third ,, × 15·1.
,, 18.—Last three segments of the pleon, and telson. × 15·1.

Gammarus pulex (Linn.).

FIG. 19.—Second thoracic limb of female. × 13·0.
,, 20.—Third ,, ,, ,, ,, × 13·0.
,, 21.—Second ,, ,, ,, male. × 13·0.
,, 22.—Third ,, ,, ,, ,, × 13·0.
,, 23.—Eighth ,, ,, ,, ,, × 13·0.
,, 24.—Fourth coxal plate. × 15·1.
,, 25.—Lower margin of third segment of pleon. × 15·1.
,, 26.—Third uropod. × 15·1.
,, 27.—Telson. × 34·3.



O. S. T. del.

Figs. 1—18. Gammarus annandalei, sp. nov.
Figs. 19—27. Gammarus pulex (Linn.)

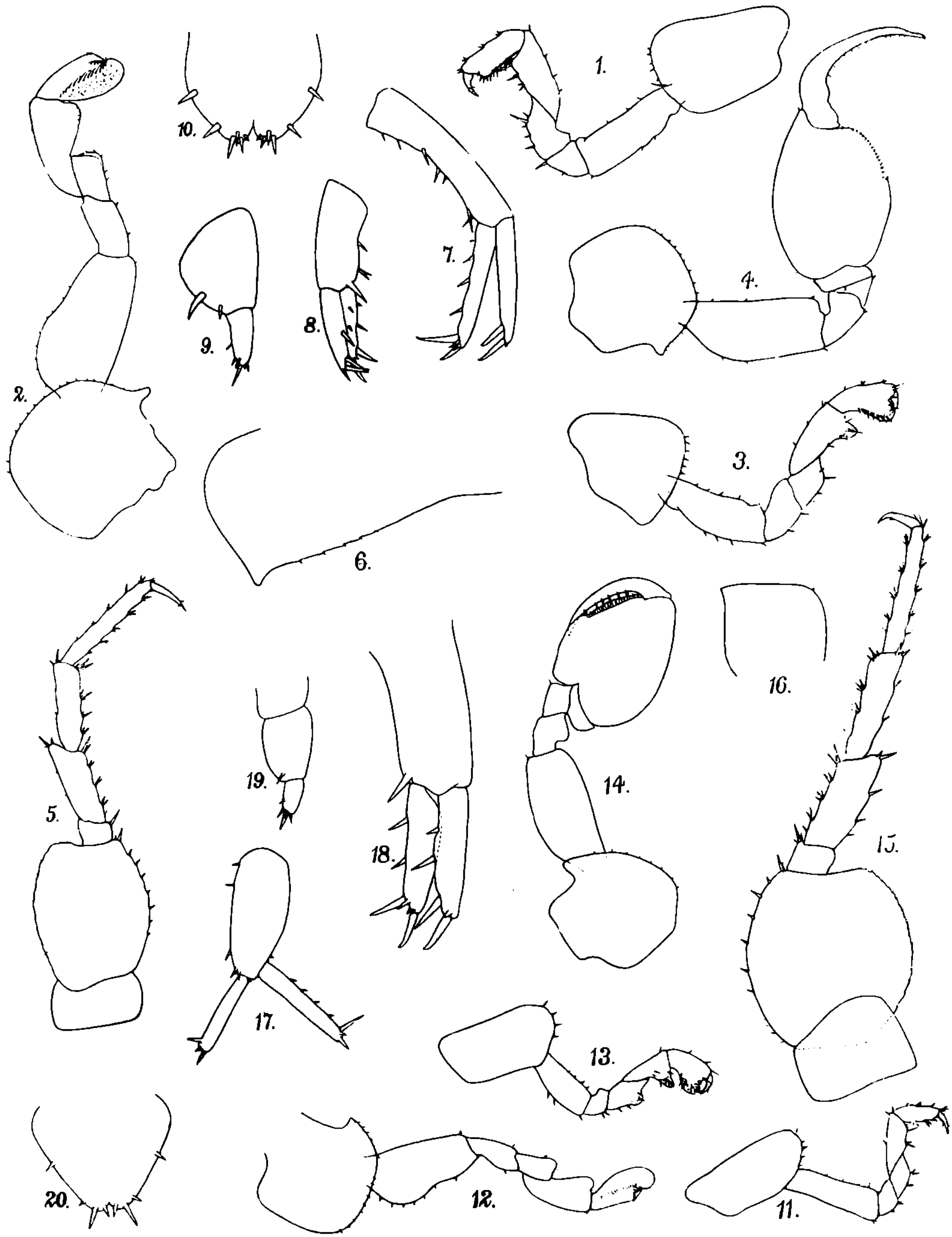
PLATE XXI.

Talorchestia japonica, n. sp.

FIG. 1.—Second thoracic limb of female. × 22·7.
,, 2.—Third ,, ,, ,, ,, × 22·7.
,, 3.—Second ,, ,, ,, male. × 22·7.
,, 4.—Third ,, ,, ,, ,, × 22·7.
,, 5.—Eighth ,, ,, ,, ,, × 15·1.
,, 6.—Lower and hinder margin of third segment of pleon. × 22·7.
,, 7.—First uropod. × 44·6.
,, 8.—Second ,, × 44·6.
,, 9.—Third ,, × 44·6.
,, 10.—Telson. × 44·6.

Talorchestia malayensis, n. sp.

FIG. 11.—Second thoracic limb of female. × 22·7.
,, 12.—Third ,, ,, ,, ,, × 22·7.
,, 13.—Second ,, ,, ,, male. × 22·7.
,, 14.—Third ,, ,, ,, ,, × 22·7.
,, 15.—Eighth ,, ,, ,, ,, × 22·7.
,, 16.—Lower hinder margin of third segment of pleon. × 22·7.
,, 17.—First uropod. × 22·7.
,, 18.—Second ,, × 44·6.
,, 19.—Third ,, × 44·6.
,, 20.—Telson. × 68·7.



O. S. T. del.

Figs. 1—10. Talorchestia japonica, sp. nov.
Figs. 11—20. Talorchestia malayensis, sp. nov.

MEMOIRS

OF THE

ASIATIC SOCIETY OF BENGAL

VOL. VI, pp. 461—530.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

EDITED BY N. ANNANDALE, D.Sc., F.A.S.B., F.R.S.

PART IX.

(Concluding the Text. Index and Title to complete the Volume.)

CALCUTTA:

PRINTED AT THE BAPTIST MISSION PRESS, AND PUBLISHED BY
THE ASIATIC SOCIETY OF BENGAL, 1, PARK STREET.

1924.

Price Rs. 3-6.

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Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

FISH OF THE TALÉ SAP, PENINSULAR SIAM.

(PART I.)

By SUNDER LAL HORA, *D.Sc.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

FISH OF THE TALÉ SAP, PENINSULAR SIAM (PART I).

By SUNDER LAL HORA, *D.Sc.*, *Officiating Superintendent, Zoological Survey of India.*

(Communicated with the permission of the Director, Zoological Survey of India.)

[The fish-fauna of the Talé Sap is interesting from several different points of view—geographical, bionomical and practical. Until the whole collection is worked out it will be impossible to discuss these views in detail, but a comparison between the list of species and that of those found in the Chilka Lake [1] is bound to be of considerable interest, for the two lakes have much in common. Both are ultimately connected by a narrow opening with a great open bay of the sea. Both are divided into two parts, an outer part directly communicating with the sea and an inner part more remote from it, and in both the water is of extremely variable salinity. There are, however, noteworthy differences, especially in the fact that the two parts of the Talé Sap are more clearly differentiated than those of the Chilka lake and that the connection with the sea is much less restricted. In the Talé Sap, therefore, there is a larger freshwater element in the fauna than in the Chilka Lake, mainly but not entirely confined to the inner region ; while on the other hand there is probably much more constant and populous immigration from the sea in the former.

This is of great importance from the practical point of view of fisheries, for there can be no doubt that the outer part of the Talé Sap acts as a nursery for the fry of many of the edible fish of the Gulf of Siam. In January, after the conclusion of the rainy season, the water is alive with fish-fry, mostly belonging to marine forms. The local fisheries inside the lake, and especially at its mouth, are of considerable value, but the lake itself is thus an asset of wider importance to the fish-eating population of Siam and the neighbouring countries.

In the following paper Dr. Sunder Lal Hora has dealt with several distinct orders and families, some mainly fluviatile, others marine and estuarine. He has not adopted any particular taxonomic classification in selecting these families, but has discussed those that it was convenient to consider at the time. He hopes to publish a further report or reports on the remaining families later. Those here considered are the families of cartilaginous fish, of the Apodes, the Siluroidea, the Cyprinoidea, the Synentognathi, Solenichthyes, Opisthomi, and Zeorhombi—*N. Annandale.*]

In the above introductory note Dr. N. Annandale has pointed out the scope of this report on the Fish of the Talé Sap. Most of the forms discussed in this paper are fairly widely distributed and the endemic element does not appear to be quite so rich as was found to be in the Chilka Lake, but this element was perhaps most apparent in families not discussed here. Two new species and one new colour variety are described. The two new species belong to the genera *Microphis* and *Mastacembelus* while the new variety is of the widely distributed species of the latter genus—*M. armatus.* The most noteworthy feature of the collection is the presence of very young specimens and it is mainly on this account that I have not been able to identify the species in two instances, namely, those of the genera *Acanthopsis* and *Dermogenys.*

[1] Chaudhuri and Hora, *Mem. Ind. Mus.* V, pp. 405–430, 443–458, 491–507, 711–769 (1916–1923).

In preparing my report on these fishes I am greatly indebted to Dr. N. Annandale and Dr. B. L. Chaudhuri, who had made a preliminary investigation of the specimens before I examined them and had separated them into their genera and in some cases into their species. To the former I am also indebted for numerous valuable suggestions during the preparation of this report.

The types of the new species are preserved in the collection of the Zoological Survey of India.

PLAGIOSTOMIA.

Family CESTRACIONTIDAE.

Cestracion blochi (Cuv.).

1913. *Cestracion blochii*, Garman, *Mem. Mus. Comp. Zool. Harvard Coll.* XXXVI, p. 156.

This hammer-headed shark is represented by two specimens in Dr. Annandale's collection from the Talé Sap. They were obtained in the outer lake at Singgora.

Cestracion blochi is quite common in the seas of India and the Malay Archipelago.

Family CARCHARINIDAE.

Scoliodon walbeehmi (Bleek.).

1913. *Scoliodon walbeehmi*, Garman, *op. cit.*, p. 112.

There are two fairly grown-up specimens of this species in the collection. The largest is about a foot and a half in length. Of the two specimens one was taken near the mouth of the Patelung river in the inner lake in fresh water, while the other was captured in the outer lake at Singgora in brackish water. This species has not so far been known to occur in fresh water.

Scoliodon walbeehmi is known from the seas of India, the Malay Archipelago and Japan.

Family RHINOBATIDAE.

Rhinobatus thouini (Lacépèd.).

1913. *Rhinobatus thouini*, Garman, *op. cit.*, p. 276.

Rhinobatus thouini is represented by a single specimen in Dr. Annandale's collection from the Talé Sap. It was captured in the outer lake at Singgora and is about 38 cm. in length. It can readily be distinguished from the other Asiatic species of the genus by the character noted down in Dr. Annandale's[1] key to the Indian Species of *Rhinobatus*. The snout is spatulate and is constricted some distance behind the tip.

This species is found in Red Sea, the seas of India and the Malay Archipelago.

Family TRYGONIDAE.

Trygon bleekeri Blyth.

1909. *Trygon bleekeri*, Annandale, *Mem. Ind. Mus.* II, p. 26, pl. iii, fig. 9.

There is a young male of this species in the collection. It is about 27 cm. across the disc and was obtained by Dr. Annandale in the outer lake at Singgora.

[1] Annandale, *Mem. Ind. Mus.* II, p. 12 (1909).

It agrees fairly closely with Annandale's description of the species, but differs in having a very narrow margin of dark brown colour on the ventral surface which in some places is not quite distinct.

Trygon bleekeri has so far been obtained off the coasts of Orissa, Bengal, and Burma and its occurrence in Siam is recorded here for the first time.

Hypolophus sephen (Forskål).

1909. *Hypolophus sephen*, Annandale, *op. cit.*, p. 35.

This species is represented by one complete specimen and one jaw in the collection. They were obtained near Singgora in the outer lake. Dr. Annandale tells me that this species also makes its way in the inner part of the lake.

Hypolophus sephen is extensively found in the seas of India and the Malay Archipelago and also occurs in the river Ganges up to about 600 miles from the mouth.

Family MYLIOBATIDAE.

Aëtobatis narinari (Euphrasen).

1910. *Aëtobatis narinari*, Annandale, *op. cit.*, III, p. 4, pl. ii, fig. 2.

There is a skin in spirit of this species in the collection. It was obtained at Singgora in the outer lake. The specimen is conspicuously spotted on the dorsal surface. Most of the spots are situated on the body and there are very few on the head. As a matter of fact there are only three spots in front of the posterior margin of the spiracle. As regards colouration this specimen is intermediate between the colour varities A and B recognised by Annandale.

This species occurs in Red Sea, seas of India and the Malay Archipelago. Its range extends to the Atlantic and the South Pacific oceans.

Family RHINOPTERIDAE.

Rhinoptera javanica Müll. and Henle.

1913. *Rhinoptera javanica*, Garman, *op. cit.*, p. 446.

In Dr. Annandale's collection from the Talé Sap, this species is represented by a head in spirit. It was obtained at Singgora.

Rhinoptera javanica is found in the seas of India and the Malay Archipelago.

SYNBRANCHOIDEA.

Family SYNBRANCHIDAE.

Monopterus albus (Zuiew).

1916. *Monopterus albus*, Weber and Beaufort, *Fish. Indo-Austral. Archipel.* III, p. 413, figs. 210 and 211.

This common and widely distributed species of the Far East is represented by three specimens in Dr. Annandale's collection from the Talé Sap. All the specimens were obtained at the mouth of the Patelung river.

The colour varies greatly in the three specimens before me. In the largest specimen the back is uniformly dark-grey while the under surface is pale white.

The other two specimens possess white spots on the sides and on the under surface; in one the spots are minute and more numerous, while in the other they are much larger and are chiefly restricted to below the lateral line.

Macrotrema caligans (Cant.).

1916. *Macrotrema caligans*, Weber and Beaufort, *op. cit.*, p. 415.

There are two young specimens of this species in the collection. One was taken near the shore at Singgora, while the other was caught near Pak Payum in the channel between the two parts of the lake. Both were taken from a soft muddy bottom.

Macrotrema caligans is know from the seas of Singapore and Penang.

APODES.

Family CONGRIDAE.

Muraenesox talabon (Cant.).

1916. *Muraenesox talabon*, Weber and Beaufort, *op. cit.*, p. 255.

Dr. Annandale obtained three half-grown specimens of this species in the outer lake at Singgora.

This species occurs in the seas of India, the Malay Archipelago and beyond.

Family OPHICHTHYIDAE.

Pisoodonophis boro (Ham. Buch.).

1916. *Pisoodonophis boro*, Weber and Beaufort, *op. cit.*, p. 297.

Three young specimens of this species are present in the collection. They were obtained in the outer lake at Singgora.

Pisoodonophis boro is found in the seas, estuaries and brackish waters of India, the Malay Archipelago and Formosa.

Family MURAENIDAE.

Muraena (Gymnothorax) picta Ahl.

1916. *Muraena (Gymnothorax) picta*, Weber and Beaufort, *op. cit.*, p. 363, figs. 175, 180.

There are several young specimens of this widely distributed Oriental and partly Ethopian species in the collection. They were captured at Singgora in the outer lake.

Muraena (Gymnothorax) thyrsoidea Rich.

1916. *Muraena (Gymnothorax) thyrsoidea*, Weber and Beaufort, *op. cit.*, *p.* 365.

This species is represented by a single specimen taken by Dr. Annandale at Singgora.

The range of *Muraena* (*Gymnothorax*) *thyrsoidea* extends from the Andamans, Burma, Penang and Indo-Australian Archipelago to Western Australia, China and Pacific Islands.

SILUROIDEA.

Family CLARIIDAE.

Clarias batrachus (Linn.).

1913 *Clarias batrachus*, Weber and Beaufort, *Fish. Indo-Austral. Archipel.* II, p. 190, fig. 74.

This common Oriental species is represented in Dr. Annandale's collection from the Talé Sap by eight young and half-grown specimens. They were collected at the following localities:—

4 Small pools and ditches near the edge of the lake at Lampam (16-1-16).
3 Shore of the Talé Sap near Singgora (20-1-16).
1 Shore of Koh Yaw (29-1-16).

Family SILURIDAE.

Callichrous bimaculatus (Bloch).

1913. *Callichrous bimaculatus*, Weber and Beaufort, *op. cit.*, p. 200.

There are several young and two half-grown specimens of this species in the collection. The young examples were obtained in small pools and ditches near the edge of the lake at Lampam, while the larger specimens were netted near the mouth of the Patelung river.

Callichrous bimaculatus is widely distributed in the Oriental Region.

Family PLOTOSIDAE.

Plotosus canius (Ham. Buch.).

1913. *Plotosus canius*, Weber and Beaufort, *op. cit.*, p. 227.

Five specimens of this species were collected from the following localities:—

3 Shore of the Talé Sap near Singgora (21-1-16).
1 Across channel from Singgora (24-1-16).
1 Shore of mainland opposite W. end of Koh Yaw at low tide (29-1-16).

Plotosus canius is found in the seas of India, Ceylon, Burma, and the Malay Archipelago. It ascends rivers far above the tidal limit.

Plotosus anguillaris (Bloch).

1913. *Plotosus anguillaris*, Weber and Beaufort, *op. cit.*, p. 229.

There are four specimens of this widely distributed species in Dr. Annandale's collection from the Talé Sap. They were obtained from near the shore of the lake at Singgora.

Family ARIIDAE.

Arius maculatus (Thunb.).

1913. *Arius maculatus*, Weber and Beaufort, *op. cit.*, p. 284

This species is represented by a single specimen in the collection. It was taken near the shore of the lake at Singgora. *Arius maculatus* occurs in seas and estuaries of Siam, Philippines, China, Riu Kiu Islands and the Indo-Australian Archipelago.

Weber and Beaufort point out in a foot-note on p. 284 that they have no material to decide whether *Arius arius* (H. B.) is identical with *A. maculatus* or not. In the collection of the Indian Museum there are two specimens of the former species, one is from Burma and was purchased from Day, while the second is from the Chilka Lake recently obtained by the Chilk Survey. Both of these are young and the arrangement of teeth on their palates differs from each other and from those of the specimen I refer to *A. maculatus*. Chaudhuri[1] is of opinion that the two species are quite distinct, but from the material in our museum I am not able to decide this question.

Arius macronotacanthus (Blkr.).

1913. *Arius macronotacanthus*, Weber and Beaufort, *op. cit.*, p. 309.

A single young specimen taken near the shore at Singgora is present in the collection. The species is already known from Java, Sumatra, Singapore and Penang.

Family BAGRIDAE.

Macrones nigriceps (C. V.).

1913. *Macrones nigriceps*, Weber and Beaufort, *op cit.*, p. 337.

This species is represented by a single specimen in the collection. It was captured near the mouth of the Patelung river. *Macrones nigriceps* is found in Siam and the Malay Archipelago.

Macrones nemurus (C. V.).

1913. *Macrones nemurus*, Weber and Beaufort, *op. cit.*, p. 341.

There are two specimens of this species from the mouth of the Patelung river in Dr. Annandale's collection from the Talé Sap.

Macrones nemurus is widely distributed in Siam and the Malay Archipelago.

CYPRINOIDEA.

Family COBITIDAE.

Lepidocephalus hasselti (C. V.).

1916. *Lepidocephalus hasselti*, Weber and Beaufort, *op. cit.*, III, p. 29, fig. 11.

There is a single immature specimens of this species in the collection. It was collected by Dr. Annandale in small pools and ditches near the edge of the lake at Lampam. The species is known to occur in Sumatra, Java and the Tenasserim District of Burma.

There is a young specimen about 24 mm. in total length which I think belongs to the genus *Acanthopsis*. I am not able to identify it specifically. It possesses long and thin barbels which are longer than the snout. The pectoral fins are almost as long as the head and are separated from the ventrals by a short distance. There are about a dozen short vertical bands along the lateral line. The dorsal

[1] Chaudhuri, *Mem. Ind. Mus.* V, p. 432 (1916).

surface and the sides are dotted with black. All the fins are provided with irregular bands of a brownish colour.

The specimen was obtained by Dr. Annandale at Lampam in small pools and ditches at the edge of the lake.

Family CYPRINIDAE.

Chela oxygastroides (Blkr.).

1916. *Chela oxygastroides*, Weber and Beaufort, *Fish. Indo-Austral. Archipel.* III, p. 51. fig. 22.

A young specimen of this species, 53 mm. in total length, was collected by Dr. Annandale round the shore of Koh Si Hah (Five Islands).

Chela oxygastroides is fairly common in the Malay Archipelago and Siam.

Rasbora argyrotaenia (Blkr.).

1916. *Rasbora argyrotaenia*, Weber and Beaufort, *op. cit.*, p. 61.

This widely distributed species of the Malay Archipelago and Siam is represented in Dr. Annandale's collection from the Talé Sap by a single immature specimen. It is 52 mm. in total length and was taken in small pools and ditches near the edge of the lake at Lampam, Patelung.

Rasbora trilineata Steind.

1916. *Rasbora trilineata*, Weber and Beaufort, *op. cit.*, p. 67.

There are three small specimens in the collection which I refer to this species, the largest is only 25 mm. in total length. In these the black blotches on the lobes of the caudal are subterminal and thus represent the typical form known from Borneo and Sumatra.

The specimens were collected in small pools and ditches near the edge of the lake at the same place as the last species.

Rasbora lateristriata var. **sumatrana** (Blkr.).

1916. *Rasbora lateristriata* var *sumatrana*, Weber and Beaufort, *op. cit.*, p. 77.

There are several young specimens of this variety in the collection. The largest among them hardly exceeds 25 mm. in length. They were taken in small pools and ditches near the edge of the lake at Lampam.

This variety occurs in Sumatra, Borneo and the Malay Peninsula.

Rasbora heteromorpha Dunker.

1916. *Rasbora heteromorpha*, Weber and Beaufort, *op. cit.*, p. 79.

This species is represented by eight specimens in Dr. Annandale's collection from the Talé Sap. The specimens are quite young and none of them is more than 17 mm. in length. They were collected in small pools and ditches near the edge of the lake at Lampam.

Rasbora heteromorpha has hitherto been known from eastern Sumatra and the Malay Peninsula.

Dr. Annandale in his valuable monograph on the fish of the Inlé Lake[1] remarked that Dunker's two species of *Rasbora*, *R. heteromorpha* and *R. maculata* might possibly belong to his new genus *Microrasbora*. In *R. heteromorpha* there is a well-marked prominence in the middle of the lower jaw and a corresponding emargination in the upper. The anal fin is not very long and contains about five branched rays. Even in general facies it is quite different looking from the two species of *Microrasbora* from the Inlé Lake which I have examined in the collection of the Indian Museum.

Osteochilus hasselti (C. V.).

1916. *Osteochilus hasselti*, Weber and Beaufort, *op. cit.*, p. 135, figs 57 and 58.

Seven young specimens of this species were collected by Dr. Annandale in small pools and ditches near the edge of the lake at Lampam and one example was captured about half a mile south of the Patelung river.

Osteochilus hasselti is fairly widely distributed in the Malay Archipelago.

Hampala macrolepidota (C. V.).

1916. *Hampala macrolepidota*, Weber and Beaufort, *op. cit.*, p. 143, fig. 60

This species is represented by a single half-grown specimen in the collection. It was taken at the mouth of the Patelung river near Lampam.

Hampala macrolepidota is found in Tenasserim, Siam, Indo-China and the Malay Archipelago.

Barbus (Puntius) sumatranus (Blkr.).

1916. *Puntius sumatranus*, Weber and Beaufort, *op. cit.*, p. 191.

There are several young specimens of this species in the collection. They represent the colour variety described by Dunker from the Malay Peninsula. Most of the specimens were taken in small pools and ditches near the edge of the lake at Lampam, while one was obtained during shore-collecting at Ban Hua Wang among small stones.

This species is found in Sumatra, Borneo and Siam.

Barbus (Puntius) javanicus (Blkr.).

1916. *Puntius javanicus*, Weber and Beaufort, *op. cit.*, p. 197.

There is only one young specimen of this species in the collection. It was collected in small pools and ditches at Lampam.

This species occurs in Java, Borneo and Siam.

Barbus (Puntius) bulu (Blkr.).

1916. *Puntius bulu*, Weber and Beaufort, *op. cit.*, p. 190.

This species is represented by two fairly grown up specimens in the collection. They were collected at the mouth of the Patelung river near Lampam. According to Weber and Beaufort this species has hitherto been known only from Sumatra and Borneo.

[1] Annandale, *Rec. Ind. Mus.* XIV, p. 50 (1918).

Barbus (Labeobarbus) tambroides (Blkr.).

1916. *Labeobarbus tambroides*, Weber and Beaufort, *op. cit.*, p. 150.

I refer with considerable hesitation a dry skin about a couple of feet in length to this species. It was obtained by Dr. Annandale at the mouth of the Patelung river near Lampam. The median lobe of the lower lip has dried up and I can make out only two short maxillary barbels in this specimen. There are 26 scales along the lateral line, 4 series of scales above it to the base of the dorsal and 1½ below it to the base of the ventral.

This species is known from Siam and the Indo-Australian Archipelago.

SYNENTOGNATHI.

Family BELONIDAE.

Tylosurus strongylurus (v. Hass.).

1922. *Tylosurus strongylurus*, Weber and Beaufort, *Fish. Indo-Austr. Archipel.* IV, p. 121.

This widely distributed species of the Oriental Region is represented in Dr. Annandale's collection from the Talé Sap by a single individual. It was procured in the outer lake at Singgora.

Tylosurus leiurus (Bleeker).

1922. *Tylosurus leiurus*, Weber and Beaufort, *op. cit.*, p. 124.

There are three specimens of this species in the collection. They were netted in the outer lake at Singgora.

Tylosurus leiurus is found in the seas of Ceylon, India, Philippines, Formosa and the Malay Archipelago.

Tylosurus annulatus (C. V.).

1922. *Tylosurus annulatus* Weber and Beaufort, *op. cit.*, p. 126.

Dr. Annandale obtained three specimens of this widely distributed species in the outer lake at Singgora. This form is quite common in the seas of India, the Malay Archipelago, Japan and North Australia.

Xenentodon cancila (Ham. Buch.).

1889. *Belone cancila*, Day, *Faun. Brit. Ind. Fish.* I, p. 420, fig. 136.

A young specimen of this species was collected by Dr. Annandale in small pools and ditches near the edge of the lake at Lampam, Patelung.

Xenentodon cancila is a fresh water form and is commonly found in India and Burma.

Family HEMIRHAMPHIDAE.

Dermogenys sp.

There are several specimens collected by Dr. Annandale in the inner lake which I have not been able to determine specifically. To facilitate reference in future I give below some of the salient features of these young specimens.

The base of the ventral is a little nearer to the head that to the base of the caudal. The length of the lower jaw beyond the extremity of the upper is about six times in length without caudal. There are nine rays in the dorsal fin and about fifteen in the anal. In certain specimens some of the anterior rays of the anal are spines and are bent backwards in such a way that they conceal some other rays behind them. The anal fin is preceded by a fold of skin. The scales have not yet developed on lateral surface. In some specimens the ventral is distinctly tipped with black. There is a black line on either side of the body in the middle. All the fins are more or less rounded.

The specific limits of the various species included under this genus are not well defined and, therefore. I have refrained myself from discussing the specimens any further.

Hemirhamphus unifasciatus Ranz.

1922. *Hemirhamphus unifasciatus*, Weber and Beaufort, *op. cit.*, p. 149.

There are four young specimens of *Hemirhamphus unifasciatus* in the collection. Of these three were obtained near the mouth of the Patelung river, while the remaining one was captured at Ban Lem Chak.

The species is widely distributed. It occurs along the Pacific coasts of Panama, the Atlantic coasts of Tropical America, the east coast of Africa, British India, Philippines, Amboina, Timor, Java and Sumatra.

Hemirhamphus melanurus (C. V.).

1922. *Hemirhamphus melanurus*, Weber and Beaufort, *op. cit.*, p. 151.

This species is represented by three young specimens in the collection. They were netted by Dr. Annandale in the outer lake at Singgora.

It appears from a note added after the description of the species by Weber and Beaufort that there is some confusion between *Hemirhamphus melanurus* and *H. güntheri*. The two species are distinguished by the number of scales along the lateral line which are 55 in the former and 58 in the latter. In my specimens the scales from the lateral surfaces have been rubbed off, but counting the number from the basal membranes, I believe, that they belong to true *melanurus* and not to *güntheri*.

This species is found in the seas of the Malay Archipelago.

SOLENICHTHYES.

Family SYNGNATHIDAE.

Microphis annandalei, sp. nov.

The new species is represented in Dr. Annandale's collection by one mature male and two young specimens, which have probably dropped out of the brood-pouch of the former. The specimens were obtained in small pools and ditches near the edge of the lake at Lampam, Patelung.

D. 30. A. 4. P. 22. C. 8; Rings 17+28; subdorsal rings 1+5.

The form is narrow and greatly elongated, it is depressed from above downwards and compressed from side to side. The shields are finely striated transversally and their keels are provided with minute serrations. The keels of the various shields run into one another and do not form spines. The superior cristae of trunk and tail are discontinuous, the lateral cristae of trunk and superior cristae of tail subcontinuous, the inferior cristae of trunk and tail continuous. The operculum is provided with a complete longitudinal keel and there are about eight radiating ridges below it. The length of the head is contained 5.7 times in the total length without the caudal. The snout is much longer than the remaining part of the head and is almost double the postorbital part of the head. The anus is situated one shield behind the commencement of the dorsal and is much nearer to the base of the caudal than to the tip of the snout. The caudal is longer than the pectoral, but considerably shorter than the postorbital part of the head. The middle rays of the caudal are the longest, while the pectoral is spread out fan-wise.

The abdominal brood-pouch is well developed and extends from the second trunk shield to the termination of the first tail-shield. Its height is greater than the body height without the pouch.

In alcohol-specimens the trunk is yellowish and the tail light gray. The head and the walls of the pouch are dirty white. A dark lateral band runs on the side of the head from the tip of snout through the eye to the gill-opening. There is a series of prominent, oval black spots on 5th to 15th trunk shields. They are less conspicuous on the anterior shields. There is an indication of a light grey band corresponding to each shield and separated by a white basal dot. The tail fin is grayish while the dorsal and the pectoral are not provided with any colour markings.

TEXT-FIG. 1.—Lateral view of type-specimen of *Microphis annandalei*, sp. nov. × $1\frac{1}{2}$.

In young specimens the colour is light olive yellow and all the trunk and tail segments are provided with vertical grey bands. A black streak runs from the eye to the tip of the snout. The middle rays of the caudal fin are deep gray.

Of the six species definitely referred to the genus *Microphis* by Dunker in his revision of the family Syngnathidae,[1] there are four that occur in the waters of the Indo-Australian Region. These four forms have quite recently been discussed by Weber and Beaufort[2] in the IV volume of their valuable book on the *Fishes of the Indo-Australian Archipelago*. *M. boaja* (Bleeker) is the only Siamese fish of this genus and differs from the new species in having a larger number

[1] Dunker, *Mitt. Naturh. Mus. Hamburg* XXXII, p. 43 (1915).
[2] Weber and Beaufort, *Fish. Indo-Austral. Archipel.* IV, p. 43 (1922).

of dorsal fin rays and in colouration. *M. annandalei* can be inserted just above *M. boaja* in Weber and Beaufort's key to the Indo-Australian species of the genus *Microphis*.

Measurements.

Total length including caudal		..	..	102·5 mm.
Length of head	..	..	..	17·3 ,,
Length of snout	..	..	..	10·0 ,,

Doryichthys deokhatoides (Blkr.).

1922. *Doryichthys deokhatoides*, Weber and Beaufort, *Fish. Indo-Australian Archipel.* IV. p. 53.

There is a single specimen of this species in the collection. It was obtained by Dr. Annandale in small pools and ditches near the edge of the lake at Lampam.

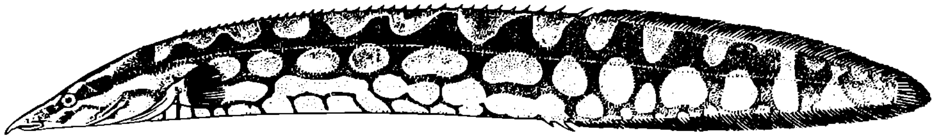
Doryichthys deokhatoides is found in the rivers and brooks of Sumatra, Borneo and the Malay Peninsula.

OPISTHOMI.

Family MASTACEMBELIDAE.

Mastacembelus armatus (Lacép.) var. favus, var. nov.

Dr. Annandale obtained two specimens from the mouth of Patelung river which I refer to this new colour variety of the widely distributed Oriental species of the genus. I have examined three more specimens of this variety from Bangkok which were found in a big collection of fish submitted to us by Dr. Malcolm Smith for identification and description. I find the colour pattern in all these specimens quite constant and very characteristic. The whole of the



TEXT-FIG. 2.—Lateral view of *Mastacembelus armatus* var. *favus*, var. nov. (much reduced, spines dissected out).

body is marked with a bold reticulation of dark brown or black bars, which enclose large oval or rounded pale spots. The upper part of the head and of the sides of the snout is dark and the whole of the lower part of the head pale with dark markings. In some specimens the reticulation extends all over the abdominal surface in the form of narrow lines, but in some it is obsolete. The vertical fins are dark. The pectoral fin is pale with a dark mark at the base of the rays.

Of the specimens of *Mastacembelus armatus* from all over India examined by me, there is none having the above described colour pattern.

Mastacembelus argus (Günth.).

1861. *Mastacembelus argus*, Günther *Cat. Brit. Mus. Fish.* III. p. 542.

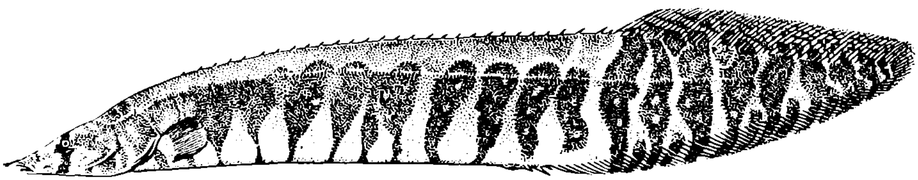
A single specimen of this species was caught by Dr. Annandale near the mouth of the Patelung river. Dr. Annandale tells me that when fresh the specimen was very dark olive green, almost black, with blood red markings.

Mastacembelus argus is endemic in Siam.

Mastacembelus circumcinctus, sp. nov.

The new species is represented by a single specimen obtained by Dr. Annandale near the mouth of the Patelung river in the inner portion of the Talé Sap. The specimen is quite young and is only 155 mm. in total length without the caudal and the fleshy appendage.

The length of the head is contained 6·2 times and the greatest depth of the body 6·6 times in the total length without the caudal. The snout is naked and is contained about 2·6 times in the length of the head. The eyes are situated wholly in the anterior half of the head. There is a well-marked preorbital spine and there are three preopercular spines. The lowermost is very small and is closely adnate to the base of the second, the third is the largest. The mouth is small and its opening does not extend to below the nostrils. The anus is provided with a well-marked papilla and is situated considerably nearer the base of the caudal than to the tip of the snout.



TEXT-FIG. 3.—Lateral view of *Mastacembelus circumcinctus* sp. nov. (slightly reduced, spines dissected out).

The dorsal fin commences above the last third of the pectoral and contains 29 spines which increase in length from before backwards except the last one which is much shorter than the one preceding it and is almost buried in the skin. The dorsal fin possesses 46 soft rays. The anal fin begins below the 25th spine of the dorsal and contains three spines and about 56 soft rays. The second spine is the largest. The vertical fins and the caudal are all continuous. The pectoral is quite small and is about one-third the length of the head.

The colour of the species in spirit is very characteristic. It is brownish on the upper surface and the sides and yellowish beneath. The head and body are marked with very characteristic dark brown bands encircling the fish. They are broader above and become narrower on the sides and the under surface. They end in a row of black spots along the base of the dorsal and are continued as short bands on the anal. A white streak runs on either side from behind the eye to the base of the caudal fin. Along the greater portion of its length it is composed of long and narrow dots which are separated from each other by a distance equal to their own length. The upper surface of the head and snout is covered with black dots and the rays of the dorsal and the caudal are provided with numerous, short, wavy lines of dark brown colour.

According to Boulenger's[1] synopsis of the species of this genus, the new species comes very close to *M. armatus* and *M. argus*. From both of these it can be readily distinguished by the fact that the mouth does not extend to below the nostrils, by the smaller number of soft rays both in the dorsal and the anal fins and lastly by its characteristic colouration.

Measurements in millimetres.

Total length without caudal	155
Length of head without appendage	25
Greatest depth of body	23·2
Length of snout without appendage	9·5
Diameter of eye	2·5
Length of pectoral	8·4

ZEORHOMBI.

Family BOTHIDAE.

Pseudorhombus arsius (Ham. Buch.).

1923. *Pseudorhombus arsius*, Hora, *Mem. Ind. Mus.* V, p. 758.

This species is represented by two young and two half grown specimens. All of them were taken in the outer lake in the neighbourhood of Singgora.

The range of this species extends from the east coast of Africa, through the seas and estuaries of India to the Malay Archipelago and Australia.

Family CYNOGLOSSIDAE.

Cynoglossus lingua (Ham. Buch.).

1889. *Cynoglossus lingua*, Day, *Faun. Brit. India Fish.* II, p. 454.

Dr. Annandale obtained three specimens of this species at Singgora in the outer lake. *C. lingua* is known from the seas and estuaries of India and its range is known to extend to the Malay Peninsula.

Family SOLEIDAE.

Synaptura orientalis (Bl. and Schn.).

1889. *Synaptura orientalis*, Day, *op. cit.*, p 440.

There are three specimens of this species in the collection. They were captured at Singgora.

The range of *Synaptura orientalis* extends from Sind, along the Western coast of India to Andamans and the seas of China.

[1] Boulenger, *Journ. Acad. Nat. Sci. Philadelphia* (2) XV, p. 197 (1912).

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ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

FISH OF THE TALÉ SAP, PENINSULAR SIAM.

(PART II.)

By SUNDER LAL HORA, *D.Sc.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

FISH OF THE TALÉ SAP, PENINSULAR SIAM (PART II).

By SUNDER LAL HORA, *D.Sc., Officiating Superintendent, Zoological Survey of India.*

(Communicated with the permission of the Director, Zoological Survey of India.)

INTRODUCTION.

The second and concluding part of the report on the fish of the Talé Sap contains a systematic treatment of 72 species, which are distributed among 42 families. The number of specimens examined has not been large since each species is represented by a few examples only. In certain cases it has been exceedingly difficult to identify the specimens specifically on account of their immaturity. Moreover, I have not been able to determine some very young forms and, therefore, notes on them have not been included in this report.

In the first part no particular taxanomic classification was adopted, but since then Jordan's useful work entitled the *Classification of Fishes*[1] has appeared. For the sake of convenience of reference I have followed Jordan in the arrangement of the species in this paper. Most of the forms discussed here are marine and are fairly widely distributed. The endemic element, as has already been pointed out, is not so rich as was found to be in the Chilka Lake. Two new species are described; they belong to the genera *Taenioides* and *Sciaenea.*

The types of the new species are preserved in the collection of the Zoological Survey of India.

Family MEGALOPIDAE.

Megalops cyprinoides (Brouss.).

1913. *Megalops cyprinoides* Weber and Beaufort, *Fish. Indo-Austral. Archipel.* II, p. 5, fig. 4.

Two specimens of this species were obtained by Dr. Annandale at the mouth of the Patalung river. *Megalops cyprinoides* is widely distributed in the Oriental Region and its range extends westwards to east coast of Africa and Madagascar and eastwards to Philippines, China and Riu-Kiu-islands. It is common in seas and estuaries and enters fresh water also.

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[1] Jordan, The Classification of Fishes. *Stanford University Publications. University series. Biological Sciences* III, pt. 2, pp. 79-243 (1923).

Family CHIROCENTRIDAE.

Chirocentrus dorab (Forsk.).

1913. *Chirocentrus dorab*, Weber and Beaufort, *Fish. Indo-Austral. Archipel.* II, p. 18, fig. 11.
1922. *Chirocentrus dorab*, (Larval and post-larval stages), Delsman, *Bijdr. Dierkunde Amsterdam* (Max Weber Feest-nummer), XXII, p. 25; *Treubia, Buitenzorg* III, pp. 38–46.

In Dr. Annandale's collection from the Tale Sap this species is represented by two large specimens and several post-larval forms. The adult specimens were obtained at Singgora, while the young forms were collected both in fresh and brackish water at several places in the lake. The following table shows the exact localities whence the larval forms were obtained in the lake, with their number and measurement in millimetres:—

No. of specimens.	Length in mm.	Locality.	Date.
1	14·6	Close in shore about ½ mile S. of Patalung river	14-1-16.
2	14, 16·5	About 1 mile due N. of South peak of Koh Si Hah	17-1-16.
1	22·0	E. Channel between Koh Yaw and mainland	24-1-16.
5	13·4–23·6	Pak Raw up channel to B. Lem Tak.	25-1-16.
1	16·0	Singgora	28-1-16.

Chirocentrus dorab is a widely distributed species. Its range extends from the east coast of Africa, through Red Sea, India, the Malay Archipelago to China and Japan. It is also found in the Philippines, Queensland and New Brittain.

Dr. Annandale,[1] on Dr. Chaudhuri's authority, referred the young of this species to the family Salangidae, with which they bear a rather close superficial resemblance.

Family CLUPEIDAE.

Hilsa toli (C.V.).

1913. *Clupea (Alosa) toli*, Weber and Beaufort, *op. cit.*, p. 64.
1917. *Hilsa toli*, Regan, *Ann. Mag. Nat. Hist.* (8) XIX, p. 306.

There is a single specimen of this species in the collection, it was obtained by Dr. Annandale at Singgora. The species is widely distributed in the seas and estuaries of India, the Malay Peninsula and Archipelago.

Hilsa kanagurta (Bleeker).

1913. *Clupea (Alosa) kanagurta*, Weber and Beaufort, *op. cit.*, p. 67.
1917. *Hilsa kanagurta*, Regan, *op. cit.*, p. 304.

This species is represented in the collection by 9 specimens, of which 4 are quite young, while the remainder are half-grown. All the nine examples were collected by Dr. Annandale at Singgora. I have carefully compared my specimens with Regan's description of the species and find that they differ in having a less deep body and a comparatively shorter head. The depth of the body is contained more than three times and the length of the head more than 4 times in the total length without the caudal. Probably the differences in proportions are due to the immaturity of the specimens.

Hilsa kanagurta is widely distributed and its range extends from Zanzibar to the Malay Archipelago.

[1] Annandale, *Journ. Nat. Hist. Soc. Siam* II, pp. 92 (1916).

Pellona elongata (Bennet).

1913. *Pellona elongata*, Weber and Beaufort, *op. cit.*, p. 90, fig. 30.

Two adult specimens of this species were collected by Dr. Annandale at Singgora. The species is widely distributed in the Oriental Region and its range extends as far east as China, Formosa and Japan.

Family DUSSUMIERIIDAE.

Dussumieria acuta C.V.

1913. *Dussumieria acuta*. Weber and Beaufort, *op. cit.*, p. 21. fig. 13.

Three specimens of this species are present in the collection, they were collected by Dr. Annandale at Singgora. The species is widely distributed in the seas of South Arabia, India, the Indo-Australian Archipelago, Philippines and China.

Family DOROSOMIDAE.

Anodontostoma chacunda (Ham. Buch.).

1913. *Dorosoma chacunda*, Weber and Beaufort. *op. cit.*, p. 25. fig. 14.

1917. *Anodontostoma chacunda*, Regan. *Ann. Mag. Nat. Hist.* (8) XIX. p. 316.

Two specimens of this species were collected by Dr. Annandale at Singgora. *Anodontostoma chacunda* is found in the seas of India and of the Indo-Australian Archipelago.

Family ENGRAULIDAE.

Setipinna melanochir (Blkr.).

1913. *Setipinna melanochir*. Weber and Beaufort, *op. cit.*, p. 28, fig. 15.

There are five specimens of this species in the collection. Two of these were obtained in the channel between B. Lem Chak and B. Pak Chaw, while the remainder were netted at Singgora.

Setipinna melanochir is found in fresh and brackish waters of Siam, Java, Sumatra, Borneo, and China.

Setipinna taty (C.V.).

1913. *Setipinna taty*. Weber and Beaufort, *op. cit.*, p. 30.

Dr. Annandale obtained a single specimen of this species at Singgora. The species occurs in the seas and estuaries of India and the Indo-Australian Archipelago.

Engraulis mystax (Bl. and Schn.).

1913. *Engraulis mystax*, Weber and Beaufort. *op. cit.*, p. 38.

There is a single specimen of this species from Singgora in the collection. The species is known from the seas and estuaries of India, the Indo-Australian Archipelago and China.

Stolephorus heterolobus Rüpp.

1913. *Stolephorus heterolobus*, Weber and Beaufort, *op. cit.*. p. 44.

This species is represented by four half-grown specimens in the collection, they were collected by Dr. Annandale at Singgora. *Stolephorus heterolobus* is found in the seas of Sumatra, Java, Lombok, Ambon and Australia. It is also known to occur in the Red Sea.

Coilia dussumieri C.V.

1913. *Coilia dussumieri*, Weber and Beaufort, *op. cit.*, p. 50.

A single specimen of this species was obtained by Dr. Annandale at Singgora. The species is commonly found in the seas and estuaries of India and the Malay Archipelago.

Family NOTOPTERIDAE.

Notopterus notopterus (Pall.).

1913. *Notopterus notopterus*, Weber and Beaufort, *op. cit.*, p. 9.

There are two fine examples of this species in Dr. Annandale's collection. They were collected at the mouth of the Patalung river. *Notopterus notopterus* is found in fresh waters of India, Burma, Siam, Sumatra and Java.

Family SYNODONTIDAE.

Saurida tumbil (Bloch).

1913. *Saurida tumbil*, Weber and Beaufort, *op. cit.*, 142.

This widely distributed species is represented by a single specimen in Dr. Annandale's collection. The specimen was netted at Singgora. *Saurida tumbil* is found in seas and along the coasts.

Family CYPRINODONTIDAE.

Panchax panchax (Ham. Buch.).

1922. *Panchax panchax*, Weber and Beaufort, *Fish. Indo-Austral. Archipel.* IV, p. 374, figs. 96, 97.

There are altogether 15 specimens of this species in the collection. They were collected by Dr. Annandale at three different places in the lake, one was obtained in small pools and ditches at the edge of the lake near Lampam, 5 from a small creek at Pak Raw, while the remaining 9 were netted during shore-collecting on Koh Yaw.

The species is of great economic importance being known to be of proved utility as mosquito-larvae destroyer. *Panchax panchax* is fairly widely distributed, its range extends from Orrisa, through the lower province of Bengal, Burma, Siam, the Andaman Islands to the Indo-Australian Archipelago. It is found both in fresh and brackish waters.

Family OSPHRONEMIDAE.

Ctenops vittatus (C.V.).

1922. *Ctenops vittatus*, Weber and Beaufort, *op. cit.*, p. 351, fig. 91.

This species is represented by several specimens in the collection. They were obtained by Dr. Annandale in fresh and brackish water in small pools and ditches at the edge of the lake and in the main area of the Talé Sap both in the inner as well as in the outer lake. The species occurs in brooks and rivers of Siam, Sumatra, Java, Borneo and Cochin-China.

Trichopodus trichopterus (Pall.).

1922. *Trichopodus trichopterus*, Weber and Beaufort, *op. cit.*, p. 366, fig. 93.

There are several young and half-grown specimens of this species in the collection. They were found by Dr. Annandale in fresh water near the mouth of the Patalung river and in brackish water at Singgora. The species is widely distributed in the Malay Archipelago. Its range extends from Bengal to Cambodia and Cochin-China.

Family ANABANTIDAE.

Anabas testudineus (Bloch).

1878. *Anabas scandens*, Day, *Fish. India* II. p. 370.

1922. *Anabas testudineus*, Weber and Beaufort, *Fish. Indo-Austral. Archipel.* IV. p. 334, fig. 86.

Four young specimens of this species were collected by Dr. Annandale in pools and ditches near the edge of the lake at Lampam. Of these 3 specimens have 18 spines in the dorsal fin, while the remaining one has only 17.

Anabas testudineus is found in fresh and brackish water of the Oriental Region and its range extends to South China and the Philippines.

Family MUGILIDAE.

Mugil dussumieri Cuv. and Val.

1922. *Mugil dussumieri*, Weber and Beaufort, *op. cit.* IV. p. 235.

This species is widely distributed in the Oriental Region. In Dr. Annandale's collection from the Talé Sap there are two half-grown and several young specimens of this species. The larger examples were obtained at Singgora, while the young ones were collected at several places in the outer lake.

Family SPHYRAENIDAE.

Sphyraena jello Cuv. and Val.

1922. *Sphyraena jello*, Weber and Beaufort, *op. cit.*, p. 222, fig. 66.

A single specimen of this species was collected by Dr. Annandale at Singgora. *Sphyraena jello* is found in seas and brackish water and its range extends from the coast of Natal through Seychelles, Madagascar, Red Sea, India, Ceylon, Riu-Kiu-Islands to Formosa and Philippines.

Family TRICHIURIDAE.

Trichiurus savala Cuv. and Val.

1878. *Trichiurus savala*, Day, *Fish. India*, p. 201, pl. xlvii, fig. 4.

Dr. Annandale netted two specimens of this species at Singgora. *Trichiurus savala* is found in the seas and estuaries of India, the Malay Archipelago and China.

Family STROMATEIDAE.

Stromateus sinensis Euphrasin.

1878. *Stromateus sinensis*, Day, *op. cit.*, p. 246, pl. li, C, fig. 6.

Dr. Annandale obtained a young specimen of this species at Singgora. *Stromateus sinensis* is quite common in the seas of India, the Malay Archipelago and China.

Stromateus cinereus Bloch.

1878. *Stromateus cinereus*, Day, *op. cit.*, p. 247, pl. liii, fig. 3.

Stromateus cinereus is represented by a single specimen in the collection. It was obtained by Dr. Annandale at Singgora. The species is found in the seas of India and its range extends to the Malay Archipelago and beyond.

Family CARANGIDAE.

Chorinemus lysan (Forsk.).

1876. *Chorinemus lysan*, Day, *Fish. Ind.* I, p. 231.
1884. *Chorinemus lysan*, Klunzinger, *Fische Roth. Meer*, p. 105.
1913. *Chorinemus lysan*, Weber, *Fische Siboga Exped.*, p. 390.

Two specimens of this species were obtained by Dr. Annandale at Singgora. In both of them the dorsal spines are flattened and hardly overlap one another. The species grows to a considerable size and its range extends from Red Sea through the seas of India to the Malay Archipelago and beyond.

Chorinemus tala C.V.

1876. *Chorinemus tala*, Day, *op. cit.*, p. 231.
1913. *Chorinemus tala*, Weber, *op. cit.*, p. 391.

This species is represented by a single specimen 93 mm. in total length without the caudal; it was obtained by Dr. Annandale at Singgora. *Chorinemus tala* is found in the seas of India and of the Indo-Australian Archipelago.

Alectis gallus (Linn.).

1876. *Caranx gallus*, Day, *op. cit.*, p. 224, pl. li, fig. 3.
1913. *Alectis gallus*, Weber, *op. cit.*, p. 400.

There are three good specimens of this species in the collection; they were found by Dr. Annandale at Singgora. *Alectis gallus* is very widely distributed; it occurs in the Red Sea, the seas of India and of the Malay Archipelago. Its range extends to the Western Pacific Islands.

Caranx carangus (Bloch).

1876. *Caranx carangus*, Day, *op. cit.*, p. 215, pl. l, fig. 4.

Dr. Annandale collected two specimens of this species at Singgora. *Caranx carangus* is found in the seas of India and of the Malay Archipelago, its range extends to the Atlantic coasts of tropical America.

Caranx djeddaba (Forsk.).

1876. *Caranx djeddaba*, Day, *op. cit.*, p. 218, pl. xlix, fig. 3.
1884. *Caranx (Selar) djeddaba*, Kulunzinger, *Fische Roth. Meer.*, p. 97.

Two half-grown specimens of this species were obtained by Dr. Annandale at Singgora. *Caranx djeddaba* is found in the Red Sea, along the East coast of Africa, in the seas of India and of the Malay Archipelago. Its range extends considerably eastwards.

Family LEIOGNATHIDAE.[1]

Leiognathus equulus (Forsk.).

1876. *Equula edentula*, Day, *op. cit.*, p. 238, lii, fig. 1.
1884. *Equula equula*, Klunzinger, *Fische Roth. Meer.* p. 107.
1923. *Leiognathus equulus*, Chaudhuri, *Mem. Ind. Mus.* V, p. 730.

There are in all seven specimens of this species in the collection. Of these 5 were obtained by Dr. Annandale at the mouth of the Patalung river near Lampam, while the remaining two were netted by him at Singgora. *Leiognathus equulus* is found in the Red Sea, the seas of India, the Malay Archipelago, China and the Philippines.

Unfortunately this species has been recorded under two different names in two separate parts of the report on the fish of the Chilka Lake (*Mem. Ind. Mus.* v, pp. 730, 761).

Gazza minuta (Bloch.).

1923. *Gazza minuta*, Chaudhuri, *op. cit.*, p. 733.

Of this species there is a single specimen in the collection found by Dr. Annandale at Singgora. The species has a very extensive distribution. It is found at Zanzibar, in the Red Sea, the seas of India and of the Malay Archipelago, New Hebrides and the Philippines.

Family APOGONIDAE.

Apogon hyalosoma, Bleeker.

1878. *Apogon hyalosoma*, Day, *op. cit.*, p. 64, pl. xvii, fig. 5.

There are three full-grown specimens and several young ones in Dr. Annandale's collection from the Talé Sap. Of the former three, two were netted at Singgora and the third at the mouth of the Patalung river. The young ones were obtained at several places in the outer lake.

Apogon hyalosoma is known from the seas of India and the Indo-Australian Archipelago. Its occurrence in fresh water is probably recorded here for the first time.

Family AMBASSIDAE.

Ambassis commersoni (Cuv. and Val.).

1878. *Ambassis commersonii*, Day, *op. cit.*, p. 52, pl. xv, fig. 3.

There are three young specimens of this species in the collection. They were obtained during shore collecting at Koh Yaw and its immediate neighbourhood.

[1] Jordan in recognising Leiognathidae as a separate family observes that "the resemblance of *Leiognathus* to *Gerres* seems to be superficial, not indicating any special affinity." See his *Classification of Fishes*, p. 180 (California: 1923).

Ambassis commersoni is a common species, its range extends from the Red Sea through the seas of India to North Australia. It ascends rivers and estuaries.

Family LATIDAE.

Lates calcarifer (Bloch).

1878. *Lates calcarifer*, Day, *op. cit.*, p. 7, pl. i, fig. 1.

This widely distributed species of the East is represented in Dr. Annandale's collection by a single specimen obtained at Singgora. *Lates calcarifer* is found in seas, backwaters and the mouths of the tidal rivers.

Family SERRANIDAE.

Serranus diacanthus Cuv. and Val.

1878. *Serranus diacanthus*, Day, *op. cit.*, p. 17, pl. iii, fig. 4.

There is a single young specimen of this species obtained by Dr. Annandale on the shore of the mainland opposite west end of Koh Yaw. The species is found in the seas of India and its range extends to the Malay Archipelago.

Serranus lanceolatus (Bloch).

1878. *Serranus lanceolatus*, Day, *op. cit.*, p. 18, pl. iv, fig. 1.

There are two specimens of this species in the collection, one was obtained at Singgora, while the other, a young one, was netted in the channel near Singgora. The range of *Serranus lanceolatus* extends from the east coast of Africa through the seas of India to the Malay Archipelago.

Serranus salmoides (Lacép.).

1878. *Serranus salmoides*, Day, *op. cit.*, p. 20, pl. iv, fig. 3.

A single specimen of this species obtained at Singgora is present in the collection. The species is found in Red Sea, the seas of India and the Malay Archipelago.

Serranus boenack (Bloch).

1878. *Serranus boenack*, Day, *op. cit.*, p. 23, pl. vi, fig. 1.

This species is represented in the collection by a single specimen from Singgora. *Serranus boenack* occurs in the seas of India and the Malay Archipelago and its range extends as far east as China.

Family LOBOTIDAE.

Datnioides quadrifasciatus (Sevastian.).

1878. *Datnioides polota*, Day, *op. cit.*, p 96, pl. xxiv, fig. 6.

1888. *Datnioides quadrifasciatus*, Day, *Fish. India Supp.*, p. 786.

Three half-grown specimens of this species were obtained by Dr. Annandale at the mouth of the Patalung river. The species is found in estuaries and within tidal influence of the Ganges and the rivers of Burma. Its range extends to the Malay Archipelago.

Family LUTIANIDAE.

Lutianus johni (Bloch).

1878. *Lutianus johni*, Day, *op. cit.*, p. 42, pl. xiii, fig. 1.

Dr. Annandale obtained a young specimen of this species at Singgora. *Lutianus johni* is found in the seas of India and its range extends to the Malay Archipelago and beyond.

Family THERAPONIDAE.

Therapon jarbua (Forsk.).

1878. *Therapon jarbua*, Day, *op. cit.*, p. 69, pl. xviii, fig. 4.

Therapon jarbua is a widely distributed Oriental species and is represented in Dr. Annandale's collection by two specimens from Singgora.

Therapon theraps Cuv. and Val.

1878. *Therapon theraps*, Day, *op. cit.*, p. 70, pl. xviii, fig. 6.

There is a single specimen of this species in the collection obtained by Dr. Annandale at Singgora. The species is found along the east coast of Africa, in the seas of India, the Malay Archipelago and China.

Family GERRIDAE.

Gerres filamentosus Cuv. and Val.

1878. *Gerres filamentosus*, Day, *op. cit.*, p. 98, pl. xxv, fig. 3.

This species is represented by three specimens in the collection. They were collected by Dr. Annandale at Singgora.

Gerrus filamentosus is found in the seas of India, and its range extends to the Malay Archipelago and beyond.

Gerres lucidus Cuv. and Val.

1878. *Gerres lucidus*, Day, *op cit.*, p. 99, pl. xxv, fig. 5.

Gerres lucidus is the commonest Indian species and is represented in the Talé Sap collection by four specimens captured at Singgora. The range of the species extends from the seas of India to the Malay Archipelago and China.

Family MULLIDAE.

Upeneus sulphureus Cuv. and Val.

1878. *Upeneoides sulphureus*, Day, *op. cit.*, p. 120, pl. xxx, fig. 3.
1913. *Upeneus sulphureus*, Weber, *Fische Siboga-Exped.*, p. 293.

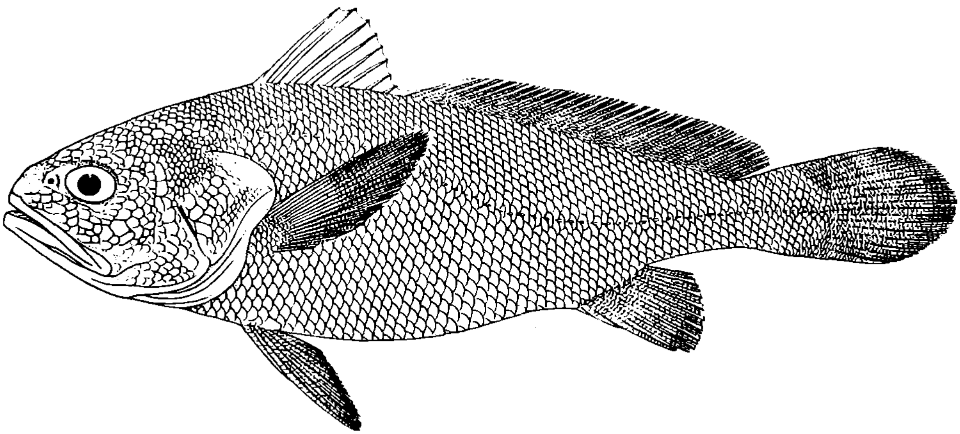
Two specimens of this species were collected by Dr. Annandale at Singgora. One of these is totally devoid of barbels under the chin, but is quite normal in all other respects. The species is found in the seas of India and the Malay Archipelago.

Family SCIAENIDAE.

Sciaena siamensis, sp. nov.

D. 9-1/29. P. 17. V. 1/5. A. 2/9.

The description of the new species is based on a single specimen obtained by Dr. Annandale at Singgora. The species is readily distinguished from the others in having larger eyes, oblique and wide mouth and short and stout anal spines. The length of the head is contained 3·75 times and the depth of the body 3·9 times in the total length including caudal. The diameter of the eye is contained 5·1 times in the length of the head. The snout is slightly longer than the eye and the inter-orbital width is about one and a half times the diameter of the eye. The maxillaries are considerably longer than half the length of the head. The dorsal commences above the base of the pectoral. The anterior dorsal consists of 9 spines, of which the third is the longest. The third spine is almost as long as the head in front of the posterior border of the eye. The second dorsal contains one spine and 29 flexible rays. The anal possesses two strong spines and 9 branched rays, the second anal spine is one-sixth the length of the head and is considerably shorter than the diameter of the eye. The pectorals are long and pointed and are shorter than the head



TEXT-FIG. 4.—Lateral view of *Sciaena siamensis*, sp. nov.[1]

by a diameter of the eye. The ventrals are thoracic and are separated from the anal by a distance equal to their length. The caudal is well developed and is almost rounded posteriorly.

The scales are present all over the body except the lips; they are cycloid on the head, feebly ctenoid on the anterior part of the body and markedly so in the posterior region. The series are obliquely arranged. The scales along the lateral line are provided with anastomosing canals. There are fifty scales along the lateral line and 9 series of longitudinal rows of scales between the lateral line and the base of the anterior dorsal fin. The lateral line is continued to the posterior end of the caudal fin. The vertical fins are covered with thin scales.

In the upper jaw there is an outer series of sharp, pointed, recurved and widely set canine-like teeth. A series of similar teeth directed inwards and backwards is present on the mandibles also. The tongue is strong and muscular and is rounded

[1] Figures 1–3 of this series have already appeared in part I of the report on the fish of the Talé Sap.

anteriorly. The operculum presents a weak, flexible point posteriorly, while all the other opercular bones are entire. There is a prominent vertical pore in the middle of the tip of the snout and 4 pores in two rows on the mandible.

The colour in spirit is silvery all over except the fins, which are slightly greyish.

Measurements in millimetres.

Total length including caudal	203
Length of caudal	35
Length of head	54
Greatest height of body	51·5
Diameter of eye	10·5
Length of snout	12·0
Interorbital width	16·5
Length of pectoral	42
Length of ventral	32
Length of second anal spine	9

Family SILLAGINIDAE.

Sillago sihama (Forsk.).

1878. *Sillago sihama*, Day, *op. cit.*, p. 265, pl. lvii. fig. 3.

In Dr. Annandale's collection there is a half-grown specimen and two young ones of this species. The former was collected at Singgora, while the latter were obtained in the channels between Koh Yaw and the mainland and between B. Pak Raw and B. Pak Cha. The species is known to ascend tidal rivers and its range extends from Red Sea through the seas of India to the Malay Archipelago and beyond.

Family NANDIDAE.

Pristolepis fasciatus (Bleeker).

1878. *Pristolepis fasciatus*, Day, *op. cit.*, p. 131, pl. xxxii. fig. 3.

There are altogether six specimens of this species in the collection, three were obtained at the mouth of the Patalung river, while the remaining were netted in small pools and ditches near Lampam.

On account of the great similarity in form and colouration Dr. Annandale [1] had erroneously referred the young examples of this species to the genus *Etroplus*, the members of which have not hitherto been found east of the Peninsular India.

Pristolepis fasciatus is found in fresh-waters of Burma, Siam and the Malay Archipelago.

Family PLATACIDAE.

Platax vespertilio (Bloch).

1876. *Platax vespertilio*, Day, *op. cit.*, p. 236, pl. li A, fig. 5.
1884. *Platax vespertilio*, Klunzinger, *Fische Roth. Meer.*, p. 118.

Dr. Annandale found a specimen of this species at Singgora. In the specimen there are faint indications of the anterior two bands but the third, which is usually

[1] Annandale, *Journ. Nat. Hist. Soc. Siam* II, p. 92 (1916).

present over the commencement of the free portion of the tail is wanting. *Platax vespertilio* has a wide distribution; its range extends from the Red Sea along the east coast of Africa through the seas of India to the Malay Archipelago and beyond.

Family DREPANIDAE.

Drepane punctata (Linn.).

1876. *Drepane punctata*, Day, *op. cit.* p. 116, pl. xxix, fig. 5.

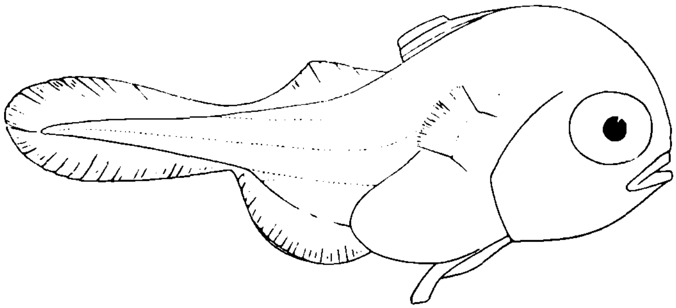
This species is represented by two specimens in the collection. Both of these were collected at Singgora. *Drepane punctata* is found in the Red Sea, along the east coast of Africa, in the seas of India, the Malay Archipelago and Australia.

Family SCATOPHAGIDAE.

Scatophagus argus (Bloch).

1876. *Scatophagus argus*, Day, *Fish. India* I, p. 114, pl. xxix, fig. 3.
1913. *Scatophagus argus*, Weber, *Siboga-Exped. Fische*, p. 302, pl. x, figs. 1-5.

Of the several specimens of this species collected by Dr. Annandale at different places in the lake, there are only 5 adult or half-grown examples, while all the remaining individuals represent larval or post-larval stages. Four of the larger individuals were obtained at Singgora, while one was netted in fresh water at the mouth of the Patalung river. The larval forms were obtained in the channel between B. Lem Chak and B. Pak Chaw and during shore-collecting at Koh Yaw. Most of the young



TEXT-FIG. 5.—Lateral view of a very young specimen (3.2 mm.) of *Scatophagus argus* (Bloch).

ones represent stages 3, 4 and 5 figured by Weber (*op. cit.*, pl. x). There is, however, one very young specimen 3·2 mm. in total length. In it the yolk is still attached to the body and the fins are not definitely localised, the caudal peduncle is long and narrow but the form of the head is very much like that of the other examples except that it is not provided with bony scutes and has two black bands running between the eyes. Unfortunately the next smaller individual is 12 mm. in length and in consequence I am not able to trace the development of the *Tholichthys* stage from the larval form.

I am indebted to Dr. Annandale for the following note on the habit of the young of this species: "The young of this species swim close to the shore in small shoals. Their transparent fins are quite invisible in water and the movements of their deeply pigmented bodies, which are often very rapid, have a very mysterious appearance in consequence."

Scatophagus argus is found in the seas of India and of the Indo-Australian Archipelago; its range extends to Australia and China.

Family TOXOTIDAE.

Toxotes chatareus (Ham. Buch.).

1878. *Toxotes chatareus*, Day, *op. cit.*, p. 117, pl. xxix, fig. 6.

There are two specimens of this species in the collection. They were collected at the mouth of the Patalung river. *Toxotes chatareus* inhabits rivers and estuaries of India, Burma and the Malay Archipelago.

Dr. Annandale obtained a young example of this genus at Koh Yaw. The specimen possesses only four dorsal spines and probably represents the variety *jaculator* of this species.

Family TEUTHIDAE.

Teuthis java (Linn.).

1878. *Teuthis java*, Day, *op. cit.*, p. 165, pl. xxxix, fig. 5.

This species is represented by 7 specimens in the collection. All of them were netted at Singgora. The range of *Teuthis java* extends from the seas of India to the Malay Archipelago and beyond.

Family PLATYCEPHALIDAE.

Platycephalus insidiator (Forsk.).

1878. *Platycephalus insidiator*, Day, *op. cit.*, p. 276.

In Dr. Annandale's collection there are two large specimens from Singgora besides a number of young examples obtained by him in the outer lake. *Platycephalus insidiator* is widely distributed and its range extends from the east coast of Africa, through Red Sea, the seas of India to the Malay Archipelago and beyond.

Family POMACENTRIDAE.

Glyphisodon caelestinus (Soland.) Cuv. and Val.

1878. *Glyphidodon caelestinus*, Day, *op. cit.*, p. 386, pl. lxxxiii fig. 2.

A single specimen of this species was obtained by Dr. Annandale at Singgora. The species is known to occur along the east coast of Africa, in the Red Sea, the seas of India, the Malay Archipelago and Polynesia.

Family ELEOTRIDAE.

Carassiops (?) caperata (Cantor).

1849. *Eleotris caperatus*, Cantor, *Cat. Malayan Fishes* in *Journ. As. Soc. Bengal*, p. 1179.

1861. *Eleotris caperata*, Günther, *Cat. Brit. Mus. Fish.* III, p. 117.

1876. *Eleotris caperata*, Day, *Fish India* I, p. 315.

There are altogether six young specimens of this species in the collection, the largest is 17·5 mm. in total length without the caudal. Of these five were obtained by Dr. Annandale during shore collecting at Koh Yaw and one at Singgora.

Great difficulty has been experienced in referring these young examples to their proper genus. In placing them in the genus *Carassiops* I have chiefly relied on McCulloch and Ogilby's [1] key to the Australian genera of the sub-family Eleotrinae, though the specimens do not possess the carp-like facies.

In my specimens the scales on the upper surface of the head are much smaller than those on the body and the black blotch usually present at the base of the pectoral fin is wanting. In other respects the Siamese's examples agree with the descriptions of the species as given by Günther and by Day.

Carassiops caperata is found along the coasts of India, the Andamans, the Malay Archipelago and China.

Measurements in millimetres.

Total length without the caudal	16·5	14·9
Length of head	6·0	5·2
Height of head	3·1	2·3
Width of head	3·6	2·6
Depth of body	3·6	2·6
Length of snout	1·8	1·5
Diameter of eye	1·2	1·5

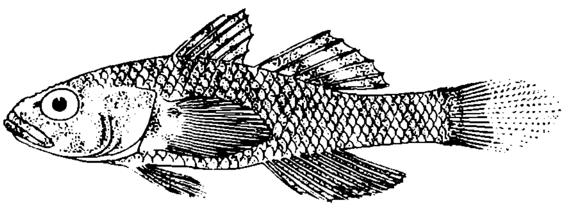
Ophiocara (?) amboinensis (Bleeker).

1861. *Eleotris amboinensis*, Günther, *Cat. Brit. Mus. Fish.* III, p. 117.

1876. *Eleotris amboinensis*, Day, *Fish India* I, p. 316.

I refer to this species a young specimen 17 mm. in total length without the caudal. It was netted by Dr. Annandale in the channel between Koh Yaw and the mainland.

Unfortunately there is no specimen either of this or of the preceding species for



TEXT-FIG. 6. Lateral view of *Ophiocara* (?) *amboinensis* (Bleeker).

comparison in the named collection of the Indian Museum and from the characters of the young specimens it is not possible for me to definitely assign them to any genus. The young specimen agrees fairly closely with the description of the species as given by the authors referred to above, except in lepidosis. The scales do not

[1] McCulloch and Ogilby, *Rec. Austral. Mus.* XII, p. 258 (1919).

seem to be properly developed as yet, the cheeks and the inter-orbital space is naked and the scales on the head are not particularly enlarged.

The species is found in the seas and estuaries of India and the Malay Archipelago.

Family GOBIIDAE.

Glossogobius circumspectus (Macleay).

1883. *Gobius circumspectus*, Macleay, *Proc. Linn. Soc. N. S. Wales* VIII, p. 267.

1919. *Glossogobius circumspectus*, McCulloch and Ogilby, *Rec. Austral. Mus.* XII, p. 235.

This species has hitherto been known from the fresh water of the Milne Bay, Papua. Dr. Annandale in his tour of the Far East obtained a specimen, which I refer to *G. circumspectus*, near the mouth of the Patalung River at Lampam. The species is characterized by the possession of an elongated, filamentous second dorsal spine and by the fact that the branched rays of the second dorsal fin increase in length posteriorly.

In my specimen the length of the head is contained 3·6 times and the depth of the body 6·3 times in the total length without the caudal. The eyes are situated nearer to the snout than to the end of the operculum and are placed in the second third of the length of the head; they are approximated dorsally and are not visible from below. The diameter of the eye is contained 5·2 times in the length of the head and 1·8 times in the length of the snout. The inter-orbital width is about two-fifths the diameter of the eye. The second dorsal spine is almost as long as the head and the last branched ray of the second dorsal is slightly longer than the longest ray of the anal and is equal to the length of the head without the snout; it reaches the rudimentary basal rays of the caudal fin. The pectoral is shorter than the head and longer than the ventral. There are 31 scales along the lateral line and 9 complete series of longitudinal scales between the anterior dorsal and the anal rays. The colour of the specimen in spirit is pale olivaceous marked with grey in places on the back and the sides of the body. The dorsal and the caudal are spotted with grey. The anal is greyish in colour.

Measurements in millimetres.

Total length without caudal	102·0
Length of head	28·0
Depth of body	16·0
Length of snout	9·5
Diameter of eye	5·3
Length of pectoral	25·5
Length of ventral	21·0

Glossogobius kokius (C.V.)

1849. *Gobius kokius*, Cantor, *Cat. Malayan Fish.* in *Journ. As. Soc. Bengal*, p. 1162.

1876. *Gobius kokius*, Day, *Fish. India*, I, p. 295.

There is a single specimen of this species 77.5 mm. in length without the caudal in the collection. It was obtained by Dr. Annandale at Singgora in the outer lake.

The species can be readily distinguished from *Glossogobius giuris*, with which it is often confused, by the possession of smaller eyes and a narrower and more pointed snout. The head is not as broad as in *G. giuris* and, moreover, the general facies is also different.

Glossogobius kokius is an entirely marine form and is found along the coasts of India, the Andamans and the Malay Archipelago. *G. giuris* has a wider distribution and occurs in fresh and brackish waters as well.

Ctenogobius alcocki (Annandale).

1906. *Gobius alcocki*, Annandale, *Journ. As. Soc.. Bengal* (n. s.) II, p. 201, fig. 1.
1923. *Ctenogobius alcocki*, Hora, *Mem. Ind. Mus.* V, p. 744.

There are several young and full-grown specimens in Dr. Annandale's collection from the Talé Sap which I refer to this species. Most of the specimens were obtained in fresh water at the mouth of the Patalung River near Lampan, while one individual was netted on the north end of Koh Si Hah during shore collecting.

I have compared in detail the Tale Sap specimens with the types of the species in the collection of the Indian Museum and find that they agree fairly closely. Two examples from the mouth of the Patalung River are about 21 mm. in total length including the length of the caudal fin; these differ slightly in colouration and proportions from the other smaller specimens. In Indian waters this species has not been recorded larger that 16 mm. in total length including the length of the caudal fin.

Ctenogobius alcocki is a fresh and brackish water form. It has hitherto been recorded from the brackish waters near Port Canning and Calcutta and from the Chilka Lake. There are two specimens of this species in the collection of the Indian Museum obtained in a tank at Rajshahi in Eastern Bengal. Recently I have collected 2 specimens of this species in a fresh-water stream at Puri.

Ctenogobius cylindriceps Hora.

1923. *Ctenogobius cylindriceps*, Hora, *Mem. Ind. Mus.* V, p. 745, figs. 26-28.

This species is represented in the collection by five specimens only. They were obtained by Dr. Annandale in the channel between Koh Yaw and the mainland. The specimens are not in a good state of preservation for detailed morphological investigations, but resemble the typical specimens from the Chilka Lake in colouration, dentition and the shape and form of the tongue. In the Siamese examples the scales have been rubbed off and the colour is very much faded. A Talé Sap specimen about 16 mm. in length is full of eggs, which are numerous and are closely packed together. The longest diameter of the egg is about 0·5 mm.

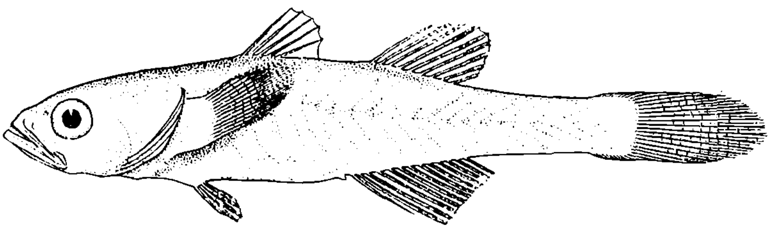
Ctenogobius cylindriceps has recently been described from numerous specimens collected in the Chilka Lake, where it is found all over the place both in fresh water and water as saline as that of the Bay of Bengal outside.

Oxyurichthys sp. (*prox.* microlepis Blkr.).

Dr. Annandale obtained three young specimens of the genus *Oxyurichthys* in the channel between Koh Yaw and the mainland which I am not able to identify specifically. Working out these examples with Günther's catalogue, they appear to represent Bleeker's *Oxyurichthys microlepis*,[1] which is found in the seas of Pinang, Java and Madura and in the Chinese Sea.

Micrapocryptes sp.

I refer two specimens 18 and 16·5 mm. in length respectively to the genus *Micrapocryptes*; they were collected by Dr. Annandale in the channel between B. Pak Raw and B. Pak Cha. I have compared these examples with the specimens of the Indian species recently described by me[2] from the Chilka Lake and the Gangetic delta and find that they do not agree with them in several important points. In the Siamese examples the body is more slender, the caudal peduncle is longer and narrower, the eyes are smaller and the mouth opening is somewhat larger.



TEXT-FIG. 7.—Lateral view of *Micrapocryptes sp.*

In the Indian species the dorsal and the anal fins are somewhat higher and contain fewer rays. The only other species of the genus known to me is *M. brachypterus*[3] (Bleeker) found in Grati Lake in Java. Of this species I have neither specimens for comparison nor a detailed up-to-date description with figures. The Siamese examples seem, on the whole, to be nearer to *M. brachypterus* than to *M. fragilis* from India.

Both the specimens collected by Dr. Annandale are either young or females, because in both the teeth are very minute and are closely set together.

Family PERIOPHTHALMIDAE.

Periophthalmus koelreuteri (Pall.).

1876. *Periophthalmus koelreuteri*, Day, *Fish. India* I, p. 303, pl. lxiv., fig. 8.

This species is represented by two specimens in the collection, one fairly grown up was obtained at Kaw Deng and the other a very young form was collected in the channel between B. Pak Raw and B. Pak Cha.

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[1] Günther, *Cat. Brit. Mus. Fish.* III, p. 49 (1861).
[2] Hora, *Mem. Ind. Mus.* V, p. 732, figs. 31–33 (1923).
[3] Günther, *Cat. Brit. Mus. Fish.* III, p. 84 (1861).

Periophthalmus koelreuteri is found in the seas and along the coasts of India, the Andamans and the Malay Archipelago. It ascends estuaries and tidal rivers.

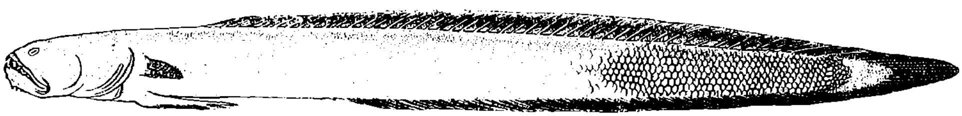
Family TAENIOIDIDAE.

Taenioides nigrimarginatus, sp. nov.

It is after considerable hesitation that I have proposed a new specific name for the four specimens obtained by Dr. Annandale at Singgora. In general facies and build the new species is very much similar to the other Indo-Australian members of the genus, but differs from all of them in the following combination of characters:—

The eyes are very small and hardly distinguishable; there are six large curved teeth in the upper jaw and eight in the lower; the posterior canines are absent in the lower jaw; small but distinct cycloid scales are present in the posterior third of the tail region and lastly all the vertical fins, which are continuous, in alcohol specimens are black forming a border almost all round the fish.

The length of the head is contained 7·5 to 7·8 times and the depth of the body 13 to 13·5 times in the length of the fish without the caudal. The height of the head near the occiput is slightly greater than half of its length, while the breadth of the head is just about half the length. The eyes are very minute and in some specimens are hardly distinguishable; they are situated high up just behind the slits of the posterior nostrils and are placed in the anterior third of the head. The cleft of



TEXT-FIG. 8.—Lateral view of *Taenioides nigrimarginatus*, sp. nov.

the mouth is oblique and extends to just below the orbit. There is an outer row of curved teeth in either jaw, three of each side in the upper jaw and four in the lower jaw. There are several villiform rows of teeth internal to these on either jaw. I have not been able to find any posterior canines in the lower jaw. There is a pair of small barbels under the symphysis of the lower jaw and a number of still smaller ones slightly behind them. The dorsal and the anal fins are united to the caudal; in the former there are six spines and about 48 branched rays, while in the latter there are about 43 rays.

Both the dorsal and the anal fins have their bases enveloped in a membrane of the skin and it is usually with great difficulty that the rays can be counted. The caudal is pointed in the middle. No scales are present on the greater part of the body, but in the last third of the tail region distinct, minute, cycloid scales are visible.

In alcohol specimens the colour of the species is very characteristic. The general surface of the body is pale olivaceous, but from behind the nape to the base of the caudal fin it is marked with bluish, oblique, transverse bands, which run from the dorsal surface to slightly below the lateral line. These markings become more prominent when a specimen is allowed to dry up a little. The dorsal, the caudal and the greater part of the anal are deep black, while the paired fins are not particularly marked.

Measurements in millimetres.

Total length without caudal	230·9	165·0
Length of head	30·5	22·3
Height of head near occiput	17·0	13·2
Breadth of head	14·6	11·0
Height of body	17·0	12·8

Trypauchen vagina (Bl. Schn.).

1876. *Trypauchen vagina*, Day, *Fish. India* I, p. 320, pl. lxviii, fig. 2.

There are three specimens of this species in the collection. They were obtained by Dr. Annandale at Singgora. The largest is about 126 mm. in length without the caudal.

Trypauchen vagina is found along the coasts and in the lagoons and estuaries of India, the Indo-Australian Archipelago and China.

Trypauchenichthys typus Blkr.

1860. *Trypauchenichthys typus*, Bleeker, *Act. Soc. Sc. Indo-Neerl.* VIII, p. 63.
1861. *Trypauchenichthys typus*, Günther, *Cat. Brit. Mus. Fish.* III, p. 138.
1874. *Trypauchenichthys typus*, Bleeker, *Arch. Néer. Sc. Nat.* IX, p. 331.

This species is represented by two specimens in Dr. Annandale's collection from the Talé Sap. Both of them were obtained at Singgora and are 168 and 162 mm. in length without the caudal respectively. The species, so far as I know, has only been known from "Sungi-duri" in Borneo and its occurrence in the Siamese waters is recorded here for the first time.

In my specimens the length of the head is contained about 6·6 times and the depth of the body 9.4 times in the total length without the caudal. The dorsal commences above the last portion of the pectoral and contains 6 spines and 56 branched rays; the anal contains 1 spine and 49 to 50 branched rays. Both the paired fins are quite small and the caudal appears to be pointed in the middle. The scales are cycloid and somewhat deciduous; there are about 55 to 58 series of scales along the lateral line, which is not represented by perforated scales. Small, rudimentary scales are present on the dorsal surface and sides of the head and on the cheeks and on the chin, but are totally absent from the region of the operculum and a portion of the dorsal surface of the body immediately behind the head. The eyes are very small and are represented by two pits only. The mouth is small and oblique and is turned upwards, the lower jaw projecting beyond the upper. There are several rows of small teeth on each jaw, those of the outer row are much larger and possess truncate or bluntly pointed apices which are in most cases coloured dark brown.

In habit and general facies the members of this genus are similar to those of the genus *Trypauchen* from which they can readily be distinguished by the possession of separate ventrals. In *Trypauchen* the ventrals are united to form a cup-shaped apparatus as is found in several other genera of the family Gobiidae.

Measurements in millimetres.

Total length without caudal	168·0	162·0
Length of head	25·3	24·0
Height of head near occiput	19·7	16·8
Width of head	15·2	13·5
Height of body	17·8	17·5
Length of snout	6·0	6·0

Family ECHENEIDAE.

Echeneis neucrates Linn.

1878. *Echeneis neucrates*, Day, *op. cit.*, p. 257, pl. lvii, fig. 1.

This species is represented in the collection by two specimens from Singgora. *Echeneis neucrates* is generally found in the tropical and temperate seas and its range is known to extend from the Red Sea through the seas of India to the Malay Archipelago.

Family TRIACANTHIDAE.

Triacanthus brevirostris Temm. and Schleg.

1878. *Triacanthus brevirostris*, Day, *op. cit.*, p. 685, pl. clxxv, fig. 1.

Dr. Annandale obtained two specimens of this species at Singgora. *Triacanthus brevirostris* is found in the seas of India and its range extends to the Malay Archipelago and beyond.

Family TETRAODONTIDAE.

Sphoeroides[1] **oblongus** (Bloch).

1878. *Tetrodon oblongus*, Day, *Fish. India* II, p. 702, pl. clxxxii, fig. 3.

There is one adult and several young specimens of this species in the collection. They were netted in the neighbourhood of Singgora and Koh Yaw. The adult specimen is from Singgora and is 143 mm. in total length including the length of the caudal fin. It agrees almost in every respect with Day's description and figure of the species.

The young examples show considerable difference in colouration and in the arrangement and form of spines. The upper surface of the head and body is greyish, while the under surface is much lighter and is almost white. There is a broad, black band, bordered both anteriorly and posteriorly with whitish lines, just behind the base of the pectoral on the dorsal surface. A similar band also passes through the base of the dorsal fin, colouring the basal portion of its rays dark. On the upper surface of the head a number of white, rounded spots are present. The fins are all

[1] According to Jordan *Sphoeroides* of Lacépède replaces *Spheroides* Duméril, see his *Classification of Fishes*, p. 240 (California: 1913).

immaculate. The spines are bristle-like and cover almost the whole of the head and body except the snout and the under surface and sides of the tail.

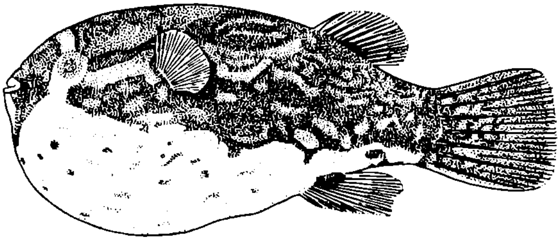
Sphoeroides oblongus is found in the seas of India, the Malay Archipelago, China, Japan and the South Sea.

Tetraodon palembangensis Bleeker.

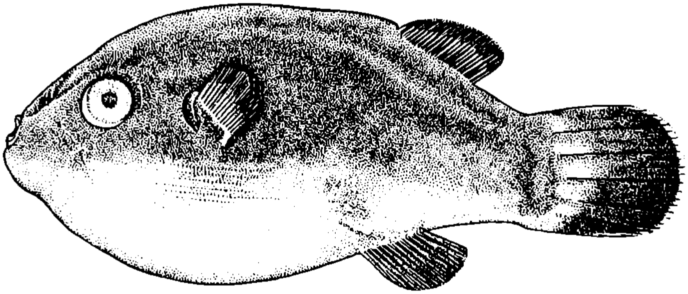
1870. *Tetrodon palembangensis*, Günther, *Cat. Brit. Mus. Fish.* VIII, p. 288.

1923. *Tetraodon palembangensis*, Hora, *Journ. Nat. Hist. Soc. Siam* VI, p. 183.

There are five young examples of this species in Dr. Annandale's collection. All of them were obtained in fresh water near Lampam. The youngest specimen is only 8 mm. in length including the length of the caudal fin.



a



b

Text-fig. 9.—*Tetraodon palembangensis* Bleeker showing variations in colouration with age.

a. Lateral view of a specimen 45 mm. in length.

b. Lateral view of a specimen 50 mm. in length.

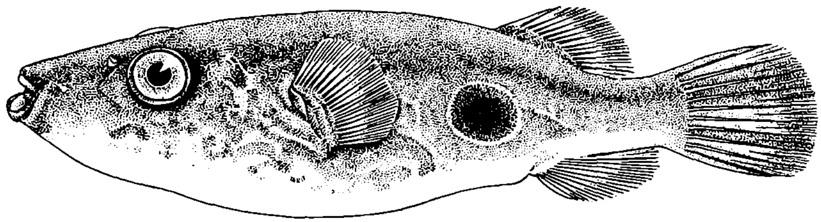
In a former paper (*op. cit.*, 1923) I have described the changes in colouration undergone by the members of this species during development. In very young examples the body is uniformly pale olivaceous with a few black dots irregularly distributed on the head and the body. Mostly these black dots are concentrated at the bases of the dorsal and the anal fins and at the sides of the mouth just behind the lower jaw.

Tetraodon palembangensis is found in the rivers of Sumatra, Borneo and Siam.

Tetraodon liuris Bleeker.

1870. *Tetrodon liuris*, Günther, *op. cit.*, p. 288.
1923. *Tetraodon liuris*, Hora, *op. cit.*, p. 184.

Two grown up individuals of this species were obtained by Dr. Annandale at the mouth of the Patalung river near Lampam. These specimens are similar to those described by me from Dr. Smith's collection from Bangkok.



TEXT-FIG. 10.—Lateral view of *Tetraodon liuris* Bleeker.

Tetraodon liuris is known from the rivers of Sumatra and Borneo and recently I have recorded it from the fresh waters of Siam.

Tetraodon fluviatilis Ham. Buch.

1878. *Tetrodon fluviatilis*, Day, *Fish. India* II. p. 707. pl. clxxxiii. fig. 1.

This species is represented in the collection by two specimens. They were obtained by Dr. Annandale at Singgora.

Day points out that "according to Bleeker, examples from the Malay Archipelago, have fewer rays than those from India, he gives D. 12-14, A. 11-12." In my specimens there are 3 undivided and 10 divided rays in the dorsal fin, the last ray being divided to the base. The anal fin possesses two simple and 9 branched rays.

The colour of the specimen agrees with Day's description except there are no colour bands on the dorsal surface and that the under surface is uniformly whitish.

Tetraodon fluviatilis is found in the seas and estuaries of India and the Malay Archipelago. Its range probably extends considerably eastwards.

SUMMARY AND CONCLUSIONS.

The fish-fauna of the Talé Sap comprises, so far as we know, 120 species, of which 34 were collected in fresh water in the inner lake, near the mouth and in the deltaic region of the Patalung river. Of the remaining 86 species, 10 (*viz.*, *Scoliodon walbeehmi*, *Hypolophus sephen*, *Clarias batrachus*, *Chirocentrus dorab*, *Panchax panchax*, *Ctenops vittatus*, *Trichopodus trichopterus*, *Leiognathus equulus*, *Apogon hyalosoma*, *Scatophagus argus*) were taken both in the inner and in the outer lake, while the remaining species were collected only in the outer lake, mostly in the neighbourhood of Singgora. *Scolidon walbeehmi*, *Apogon hyalosoma* and probably *Leiognathus equulus* are recorded here from fresh water for the first time.

Most of the species represented in the collection being marine, are widely distributed; the freshwater forms represent an Indo-Australian element and include certain forms, which are found also in Burma and India. The endemic element consists of 4 species, which are described here as new; they are distributed among the families Syngnathidae, Mastacembelidae, Sciaenidae and Taenioididae. The species of the former two families are freshwater forms, while those of the latter are marine. Certain species such as *Trygon bleekeri* and *Barbus* (*Puntius*) *bulu* are recorded from Siam for the first time.

In instituting a comparison between the fish-fauna of the Talé Sap and that of the Chilka Lake it has to be borne in mind that in the former lake Dr. Annandale worked alone for about three weeks at the extreme end of the wet and the beginning of a dry season, which is not at all a favourable time for making a collection of Zoological material. The collection from the Chilka Lake is more complete as it was the result of observations made at different seasons and at frequent intervals. Moreover, in the case of the Chilka Lake the fauna was studied from the point of view of varying conditions due to hydrographic and other changes. This is one reason which explains the fact that most of the fishes collected at Singgora are marine and those at the mouth of the Patalung river are freshwater forms. Moreover, the inner and the outer parts of the Talé Sap are much better differentiated than those of the Chilka Lake and seasonal variations in salinity, etc., of the former, of which unfortunately we have no data, must be quite different from those of the latter.

One fact is clear, that there are more species of fish in the Talé Sap than in the Chilka Lake. Leaving aside the widely distributed marine element in the fauna of the two lakes, in the Talé Sap Indo-Australian forms predominate, while in the Chilka Lake, as is but natural, Indian forms are commonly found. That a very small endemic element is found in the Talé Sap, as compared with that of the Chilka Lake, is probably due to the fact that the collection from the former was less complete. However, in both cases the most interesting forms are to be found among the small gobies. My new genus *Micrapocryptes* from the Chilka Lake and the Gangetic delta is represented by two specimens in the Talé Sap collection which unfortunately are not in good condition for specific identification. *Ctenogobius cylindriceps* Hora, described from the Chilka Lake, is also found in the Talé Sap. *Ctenogobius alcocki* (Annandale) an Indian species and widely distributed in the Chilka Lake, is represented by several specimens in Dr. Annandale's collection from the Talé Sap.

Another observation worth recording is the fact that Talé Sap serves as a nursery for a large number of fish species. In Dr. Annandale's collection at least 15 to 20 % of the species are represented by young individuals, and it may also be taken into consideration that I have not been able to determine several post-larval or very young forms. Among others the following species of economic importance were found to breed in the lake: *Clarias batrachus*, *Callichrous bimaculatus*, *Chirocentrus dorab*, *Hilsa kanagurta*, *Panchax panchax*, *Mugil dussumieri*, *Serranus lanceolatus*, *Sillago sihama*, *Scatophagus argus*, etc., etc.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

FISH OF THE TAI-HU, KIANGSU PROVINCE, CHINA.

By Henry W. Fowler.

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

FISH OF THE TAI-HU, KIANGSU PROVINCE, CHINA.

By HENRY W. FOWLER
of the Academy of Natural Sciences of Philadelphia.

INTRODUCTORY NOTE.

[Most of the fish described in this report were purchased from fishermen on the Tai Hu and were undoubtedly from the lake. A few, however, were bought in the market at Soochow. Some of these were said to come from Ningpo, but the rest appeared to be of local origin. The only fish I took commonly in my dredge was *Leucosoma chinense*, half-grown individuals of which were evidently fairly abundant in the lake in December on a soft muddy bottom.

Dr. Fowler, in collaboration with Mr. Barton A. Bean, has already described a collection of fishes from Soochow most of which probably exist in the Tai Hu (*Proc. U. S. Nat. Mus.* LVIII, pp. 307–321, 1921). This collection included specimens of the following species not represented in my own:—

Coilia clupeoides (Lacépède).
Salanx cuvieri Cuvier and Valenciennes.
Pseudogobio sinensis (Kner).
Myloleuciscus atripinnis Garman.
Hyporhamphus sinensis (Günther).
Collichthys lucidus (Richardson).
Minous monodactylus (Schneider).
Trachidermis fasciatus (Heckel).
Micropercops dabryi Fowler and Bean.
Butis butis (Hamilton Buchanan).
Cynoglossus abbreviatus Gray.

It is probable that our knowledge of the fish-fauna of this area is still far from complete, but the two collections together give us at any rate some idea of its peculiarities. The occurrence of young fish of the estuarine family Salangidae in the lake is noteworthy, while the existence of such marine genera as *Minous* and *Cynoglossus* so far from the sea is also interesting, if these species were captured actually at Soochow.—*N. Annandale.*]

The fishes in this collection were all obtained near Soo Chow in 1915. They were forwarded to Philadelphia on the "City of Lahore," which left Calcutta, July 6, 1922. Owing to the writer's absence in Hawaii and the neglect of our agent, they were not located until over a year later. It was, therefore, not possible to begin work on them before December 1, 1923, and the present list was not completed until December 27. All were later returned to the Indian Museum to be installed in that institution.

Though none of the species are new to science, some are of particular interest for their rarity and locality. Descriptive items have therefore been supplied where desirable, especially with reference to variation.

I wish to express my great indebtedness to Dr. Nelson Annandale for placing this valued collection in my hands to study and report.

SALANGIDAE.

Leucosoma chinense (Osbeck).

Ice fish. Chinese White Bait.

Head $4\frac{3}{5}$ to $5\frac{1}{4}$; depth $1\frac{3}{5}$ to $2\frac{1}{4}$ in head; D. III, 10 to III, 18; A. II or III, 25 to 29 (23 in young); P. I, 22 to 24.

Body greatly compressed, deepest at dorsal origin. Caudal peduncle well compressed, least depth about half its length or $4\frac{1}{2}$ to $5\frac{3}{4}$ in head. Head strongly depressed, width 2 to $2\frac{1}{4}$ in its length, snout greatly depressed; $3\frac{1}{4}$ in head, measured from upper jaw tip. Eye large, partly ventral, less than snout and 2 in interorbital. Maxillary reaches opposite middle of eye; $2\frac{1}{10}$ to $2\frac{4}{5}$ in head (from tip of upper jaw). Row of short strong teeth along each maxillary edge and large teeth in row along each mandibular edge. Interorbital broad, lèvel, about $\frac{1}{3}$ of head (from tip of upper jaw). Gill-opening extends forward opposite hind edge of pupil. Gill-rakers 2 + 13, lanceolate, about as long as gill-filaments or $\frac{3}{5}$ of eye. Dorsal origin midway between gill-opening and caudal base; first branched ray $1\frac{3}{4}$ to 2 in total length of head. Anal inserted entirely behind depressed dorsal and little nearer caudal base than ventral origin; first branched ray $1\frac{3}{5}$ to $1\frac{2}{3}$ in total head. Caudal forked, little shorter (damaged) than head. Pectoral $1\frac{3}{5}$ to $2\frac{1}{2}$ in head. Ventral inserted much nearer pectoral origin than anal, depressed fin not reaching opposite dorsal origin, $1\frac{1}{4}$ to $1\frac{3}{4}$ in head. Adipose fin small, above last fourth of anal. Uniform brownish, scarcely paler below. Length to 175 mm.

Thirteen examples. Small examples all have a short snout and much fewer dorsal and anal rays.

MONOPTERIDAE.

Fluta alba (Ziuew).

One example 427 mm. Brown above, lower surface paler to whitish.

ANGUILLIDAE.

Anguilla japonica (Schlegel).

Head $7\frac{1}{10}$ to $8\frac{2}{5}$; depth $19\frac{1}{3}$ to $21\frac{1}{5}$; snout 5 to $5\frac{2}{5}$ in head measured from upper jaw tip; eye $10\frac{1}{4}$ to $13\frac{1}{3}$; mouth cleft $3\frac{1}{5}$ to 4; interorbital 5 to $5\frac{1}{5}$; pectoral $2\frac{7}{8}$ to $3\frac{1}{6}$. Length of head less than space between dorsal and anal origin. Angle of mouth behind hind edge of eye. Lips thick. Space between dorsal origin and vent $2\frac{3}{4}$ to $2\frac{7}{8}$ in predorsal space. Predorsal region $3\frac{1}{3}$ to $3\frac{2}{5}$ in total length. Largely uniform brown, but little paler below. Length 281 to 350 mm

Two examples.

SILURIDAE.

Parasilurus asotus (Linné).

Head $4\frac{1}{2}$; depth $5\frac{3}{4}$; D. I, 4; A. 81; snout $3\frac{1}{5}$ in head; eye $8\frac{2}{3}$; mouth width 2; interorbital $2\frac{1}{10}$; caudal $1\frac{7}{8}$; pectoral $1\frac{7}{8}$; ventral $2\frac{1}{2}$; length of dorsal $2\frac{1}{2}$; maxillary barbel not quite reaching opposite dorsal origin. Length 225 mm.

One example.

Fluvidraco fluvidraco (Richardson).

Head $3\frac{1}{5}$; depth $3\frac{1}{2}$; D. I, 7; A. v, 16; snout 3 in head; eye $4\frac{3}{4}$; mouth width $2\frac{1}{2}$; interorbital $2\frac{2}{5}$; head width $1\frac{1}{3}$; maxillary not quite reaching eye. Maxillary barbel about reaches hind edge of gill-opening, nasal barbel only extends little behind eye. Outer mental barbel reaches pectoral origin; inner mental barbel $\frac{3}{4}$ of outer. First dorsal ray $1\frac{1}{5}$ in head; spine $1\frac{2}{5}$, front edge smooth and 4 weak antrorse serrae on hind edge. Fourteenth anal ray $2\frac{1}{2}$ in head; adipose fin $1\frac{7}{8}$; caudal 1; pectoral spine $1\frac{3}{5}$, front edge finely denticulated, inner edge with 8 antrorse serrae, humeral process $2\frac{1}{10}$; least depth of caudal peduncle equals its length or $3\frac{1}{8}$ in head. Along back and sides about 4 or 5 obscure dark brownish blotches. Fins more or less darker terminally. Length 90 mm.

One example.

Liocassis longirostris (Günther).

Head $3\frac{7}{8}$; depth $5\frac{1}{3}$; D. I, 7; A. v, 12; P. I, 9, 1; V. 1, 5; snout $2\frac{2}{5}$ in head; eye, 13; mouth width $2\frac{7}{8}$; interorbital $3\frac{1}{3}$.

Body long, compressed, deepest at dorsal origin, where back little elevated, caudal peduncle compressed, least depth $2\frac{1}{2}$ its length or $4\frac{1}{8}$ in head.

Head large, width $1\frac{1}{3}$ its length. Snout conic, depressed, length $\frac{4}{5}$ its width at front of eyes. Eye small, without free lids, hind edge little less than eye-diameter before center in head length; about 5 in snout, 4 in interorbital; mouth broad, transverse, preoral length half its width. Teeth slender, conic, in broad bands, upper little larger. Broad transverse band over front of vomer, much wider than front-band in upper jaw, small slender maxillary barbel, $1\frac{1}{2}$ in snout, reaches opposite hind edge of eye. Outer mental barbel same length; inner $\frac{2}{3}$ of outer. Very short nasal barbel little shorter than eye.

Nostrils small, about level with eye at least $\frac{2}{5}$ in snout length. Interorbital elevated convexly. Median fontanel extends backward about $\frac{3}{4}$ in head. Occipital bridge complete with dorsal buckler, surfaces of all finely striate.

Gill-opening forward midway in head. Gill-rakers 4+12, lanceolate, small, $1\frac{1}{4}$ in gill-filaments, which equal $1\frac{2}{3}$ eye diameters. Isthmus wide.

Skin smooth. Lateral line distinct, median along side, complete. Surface of humeral process little roughened, striae rather obsolete.

Dorsal origin little nearer snout tip than hind edge of adipose fin; spine long, compressed, with fine reticulated striae, with 20 strong antrorse denticles along hind edge, spine length $1\frac{1}{2}$ in head; first branched ray $1\frac{1}{4}$. Adipose fin rather long, base about half of head and begins slightly nearer dorsal origin than caudal base.

Anal begins little before origin of adipose fin; first branched ray $2\frac{1}{10}$ in head. Caudal forked, lobes slender and pointed, upper slightly longer, $1\frac{1}{3}$ in head. Pectoral with very strong compressed spine, with 21 strong antrorse spines along its inner edges, spine length $1\frac{2}{3}$ in head; fin reaches beyond front of first dorsal, $1\frac{2}{5}$ in head, $\frac{3}{5}$ of space to ventral. Ventral inserted midway between eye center and caudal base, fin reaching anal, 2 in head. Vent close before anal.

Warm brownish, paler below and on lower sides, belly and under parts whitish. Fins all pale brownish. Length 449 mm.

One example, bought in the market at Soo Chow, and said to be from Ningpo.

COBITIDIDAE.

Misgurnus anguillicaudatus (Cantor).

Head $5\frac{1}{6}$ to $5\frac{3}{5}$; depth $6\frac{1}{5}$ to $7\frac{1}{3}$; D. II, 7; A. III, 5; scales 96 to 118 in median lateral series from above gill-opening to caudal base; 24 or 25 scales transversely; about 62 predorsal scales; snout $2\frac{1}{2}$ to $2\frac{2}{3}$ in head; eye 6 to $6\frac{2}{5}$; interorbital $4\frac{2}{5}$ to $4\frac{3}{4}$. Rudimentary caudal rays excessively developed in larger example, broad, conspicuous and extend forward to tips of depressed dorsal and anal. In smaller example moderately developed. Length 127 to 170 mm.

Two examples.

CYPRINIDAE.

CYPRININAE.

Carassius auratus (Linné).

Head $2\frac{4}{5}$ to $3\frac{3}{4}$; depth $2\frac{2}{3}$; D. II, 17, I or 18, I; A. II, 6, I; scales 25 to 27 in lateral line to caudal base and 2 or 3 more in latter; snout $3\frac{1}{2}$ to $3\frac{2}{3}$ in head; eye $3\frac{1}{8}$ to 5; maxillary 4; interorbital $2\frac{1}{3}$ to $2\frac{1}{2}$. Dorsal and anal with hind edges of spines well serrated, 10 more on former and 17 on latter. Opercle with radiating rugose striae. In young ends of paired fins dusky terminally. Four examples, 57 to 225 mm.

RHODINAE.

Paracheilognathus imberbis (Günther).

Head $3\frac{3}{4}$; depth $3\frac{1}{5}$ to $3\frac{1}{3}$; D. II or III, 9; A. II or III, 9; scales 32 to 35 in lateral line to caudal base and 2 more on latter; 6 scales above lateral line, 3 or 4 below to anal origin; predorsal 12 to 14 scales; snout $3\frac{1}{2}$ in head; eye $2\frac{3}{4}$ to $2\frac{7}{8}$; maxillary $3\frac{1}{3}$ to $3\frac{1}{5}$; interorbital $2\frac{3}{4}$ to 3.

Body elongately fusiform, well compressed, deepest at dorsal origin. Caudal peduncle well compressed, least depth $1\frac{1}{5}$ to 2 in its length or $2\frac{1}{5}$ to $2\frac{1}{4}$ in head.

Head well compressed, width 2 to $2\frac{1}{10}$ in its length, snout conic, length $\frac{2}{3}$ its width. Eye large, hind pupil edge midway in head, greater than snout, mouth oblique, lower jaw slightly included within upper. Maxillary reaches nostrils, with short barbel terminally on outer surface. Lips rather fleshy. Nostrils together, at last fourth of snout, hind one much larger. Interorbital slightly convex. Gill-opening forward opposite hind pupil edge. Gill rakers about $1+7$ short points, $\frac{1}{4}$ of gill-filaments or $1\frac{2}{3}$ in eye. Pseudobranchiae equal gill-filaments. Scales in even longitudinal series, all rather narrowly imbricated and largest on middle of sides; 5 to 23 irregularly waved radiating apical striae; circuli moderate. Dorsal origin little nearer snout tip than caudal base; first branched ray 1 to $1\frac{1}{6}$ in head. Anal begins opposite last fourth of dorsal base or midway between pectoral and caudal bases; first branched ray $1\frac{3}{5}$ in head. Caudal well forked, little longer than head. Pectoral not quite reaching ventral; $1\frac{1}{8}$ to $1\frac{2}{5}$ in head. Ventral reaches anal, inserted trifle before dorsal origin; $1\frac{1}{6}$ to $1\frac{1}{2}$ in head.

Brownish generally. Lateral median vertebral leaden streak, darker on sides of caudal peduncle. Dusky spot little less than eye about third and fourth scales of lateral line and another, smaller, on front of dorsal just below middle. Iris silvery white. Fins pale. Two examples, 57 and 58 mm.

Rhodeus maculatus Fowler,[1] from the Pei Hoat Tren Tsin, is evidently the young.

Acanthorhodeus asmussi (Dybowsksi).

Head $2\frac{1}{8}$ to 4; depth 2 to $2\frac{1}{3}$; D. III, 12, I to 17, II; A. II or III, 10, I to 13, I; scales 32 to 34 in lateral line to caudal base and 3 more on latter; 6 scales above lateral line to dorsal and 5 below to anal; 14 or 15 predorsal scales; snout $3\frac{1}{8}$ to 4 in head; eye $2\frac{4}{5}$ to $3\frac{1}{8}$; maxillary $3\frac{1}{2}$ to $4\frac{1}{4}$; interorbital $2\frac{1}{2}$ to $2\frac{2}{3}$.

Body deeply ovoid, strongly compressed, deepest at dorsal origin. Caudal peduncle compressed, least depth 1 to $1\frac{2}{3}$ its length or $1\frac{7}{8}$ to $2\frac{1}{6}$ in head.

Head width $1\frac{4}{5}$ to 2 in its length. Snout convex, in profile little less than eye; length $\frac{1}{2}$ to $\frac{2}{3}$ its width. Eye large, little less than interorbital, hind edge about midway in head length. Mouth small, inferior, lower jaw slightly included in upper, gape short. Maxillary mostly concealed, reaches opposite hind nostril; with short though distinct terminal barbel, at least in largest example. Jaw edges firmly trenchant. Lips thin, narrow. Nostrils together; front one simple pore near last fourth in snout; hind one greatly larger and exposed in crescent, at least 3 times front one. Interorbital broadly convex; preorbital little over half of eye; first suborbital narrow, half width of second, which nearly covers cheek; postorbital narrow, like first suborbital. Opercle with few obsolete radiating striae.

Gill-opening extends forward opposite preopercle ridge. Gill rakers $1+7$ short firm points, about $\frac{1}{5}$ length of gill-filaments. Pseudobranchiae $\frac{2}{3}$ of gill-filaments. Pharyngeal teeth 5-5, compressed, each with moderately narrow grinding surface and lower surface of each tooth with row of short transverse blackish bars.

Scales narrowly imbricated, in even longitudinal series, rows of slightly smaller ones along bases of dorsal and anal; 33 to 45 apical radiating striae; circuli fine. Lateral line straight along side from upper angle of shoulder to middle of caudal base; each tube simple and extends about over half of each scale exposure.

Dorsal origin little nearer snout tip than caudal base, 2 front simple rays

[1] *Proc. Acad. Nat. Sci. Philadelphia*, 1910, p. 476, fig. 1.

osseous; second branched dorsal ray $1\frac{1}{10}$ to $1\frac{1}{6}$ in head. Anal like soft dorsal, smaller, begins about midway between gill-opening and caudal base; first branched ray $1\frac{1}{4}$ to $1\frac{1}{3}$ in head. Caudal well forked, pointed lobes little greater than head. Pectoral low, pointed, reaches $\frac{4}{5}$ to $\frac{7}{8}$ to ventral; 1 to $1\frac{1}{8}$ in head. Ventral inserted little before dorsal origin, reaches anal or $1\frac{1}{5}$ to $1\frac{1}{3}$ in head.

Dull brownish generally, paler to whitish below. Dorsal with 2 or 3 longitudinal deeper brownish streaks. Other fins pale. Belly and lower surface pale or whitish. Iris silvery white. Leaden vertebral streak along side from above ventral and most distinct and widest at front of caudal peduncle. Four examples, 62 to 108 mm.

BARBINAE.

Barbus schlegeli (Günther).

Head $3\frac{2}{3}$; depth $3\frac{2}{3}$; D. III, 7, I; A. III, 6, I; P. I, 19; V. I, 9; scales 44 in lateral line to caudal base and 3 more on latter; 7 scales above lateral line and 6 below; 15 predorsal scales; snout $2\frac{1}{2}$ in head; eye $5\frac{3}{4}$; maxillary $3\frac{1}{5}$; interorbital $3\frac{1}{6}$.

Body elongate, slender, well compressed, deepest at dorsal origin, edges all convexly rounded. Caudal strongly compressed, least depth $1\frac{1}{2}$ in its length or $2\frac{2}{5}$ in head. Head compressed, width $1\frac{3}{4}$ its length; profiles about evenly inclined; many mucous cavities around eyes and along preopercle flange. Snout conic, well protruded beyond lower jaw; long as wide. Eye with hind pupil edge midway in head length; 2 in snout, $1\frac{3}{4}$ in interorbital. Mouth inferior, rather small, lower jaw shorter; maxillary reaches opposite hind nostril; with terminal barbel about $\frac{2}{3}$ of eye. Lips coriaceous, rather narrow, firm. Nostrils together, anterior near last third in snout, with flap behind largely covering posterior, which little smaller. Interorbital convex. Bones of head smooth, especially opercle.

Gill-opening extends forward about opposite vertical preopercle ridge. Gill rakers v+v, short, low, tuberculate stumps, about $\frac{1}{3}$ of gill-filaments, which equal eye. Pseudobranchiae half of gill-filaments.

Scales large, little smaller on caudal peduncle and breast; free pointed axillary ventral scale $2\frac{1}{3}$ in fin; apical radiating striae about 33, fine; circuli fine. Lateral line complete, midway along side; tubes simple and each extends well over scale exposure.

Dorsal origin midway between snout tip and caudal base; first branched ray $1\frac{1}{8}$ in head; third simple ray greatly enlarged, osseous. Anal entirely behind depressed dorsal or first branched ray 2 in head. Caudal well forked, lobes rounded, but slightly less than head. Pectoral not quite reaching ventral, $1\frac{1}{4}$ in head. Ventral inserted little before dorsal origins, $1\frac{3}{5}$ to anal, $1\frac{2}{5}$ in head. Vent close before anal.

Brown, on back base of each scale with dark spot. About 6 rows of dusky small spots on caudal. Dorsal sparsely and irregularly spotted with dusky. Lower surface of body paler than upper. One example, 327 mm.

GOBIONINAE.

Pseudogobio rivularis (Basilewsky).

Head $3\frac{1}{4}$; depth $4\frac{1}{4}$; D. III, 7, I; A. II, 5, I; scales 33 in lateral line to caudal base and 2 more on latter; 6 scales above lateral line, 4 below; 13 predorsal scales; snout $2\frac{3}{5}$ in head length; eye $4\frac{1}{8}$; maxillary $4\frac{1}{2}$; interorbital $3\frac{2}{3}$; head width $1\frac{3}{4}$. Faded uniform brownish generally. Traces of 7 dark median lateral blotches, each about size of eye. Dorsal and caudal each with 6 transversely dusky lines. Small black spot at middle of caudal base less than pupil. One example, 68 mm.

Pseudorasbora parva (Schlegel).

Head $4\frac{1}{5}$; depth $3\frac{2}{3}$; D. III, 7, I; A. III, 6, I; scales 33 in lateral line to caudal base and 3 more on latter; 5 scales above lateral line, 4 below; 14 predorsal scales; snout 3 in head measured from upper jaw tip; eye $3\frac{3}{4}$; maxillary $3\frac{4}{5}$; interorbital $2\frac{1}{3}$; Head width $1\frac{3}{4}$ in its total length. Brownish generally. Edge of each scale in back and sides with vertical streak of darker. Median lateral gray streak from snout to caudal base medianly, broader and most distinct on side of caudal peduncle. Fins brown. One example, 107 mm.

HYPOPHTHALMICHTHYINAE.

Hypophthalmichthys molitrix (Valenciennes).

Head $2\frac{2}{3}$; depth $3\frac{1}{3}$; D. III, 7, I; A. III, 13, I; P. I, 13; V. I, 8; 90 tubular scales in lateral line to caudal base and 8 more in latter; 26 scales above lateral line, 17 below to anal origin; 53 predorsal scales; snout $3\frac{1}{4}$ in head measured from upper jaw tip; eye $6\frac{3}{5}$; maxillary $3\frac{3}{5}$; interorbital $2\frac{1}{2}$.

Body strongly compressed, deep, postventral little trenchant, otherwise edges all convexly rounded and greatest depth at ventral origin. Caudal peduncle well compressed, least depth $1\frac{3}{4}$ its length or $3\frac{4}{5}$ in head.

Head large, deep, strongly compressed, width $2\frac{1}{3}$ its length; upper profile slightly concave anteriorly and with upper jaw little protruded upward. Snout wide, convex, obtuse, length $\frac{3}{5}$ its width. Eye subinferior, faces downwards, hind edge at first $\frac{2}{5}$ in head length; diameter $2\frac{1}{6}$ in snout or 3 in interorbital. Mouth large, wide, rather shallow mandible slightly projecting when closed. Maxillary greatly inclined, reaches front nostril, largely covered by preorbital; lower edge about level with lower pupil edge. Upper jaw edge firmly trenchant and mandibular edge broadly obtuse. Tongue free, pointed in front, wide. Nostrils together, superior close before upper front eye edge well above eye; hind one more slit-like and larger. Interorbital convex. Preorbital about as long as eye; other suborbitals all narrow. Opercle with many fine radiating striae.

Gill-opening extends forward little less than half way in head, not to eye. Gill-rakers annectant, as fine reticulations, about 70 + 288 series; length $\frac{4}{5}$ of eye or $\frac{3}{4}$ of gill-filaments. No pseudobranchiae. Isthmus narrow, slender, lower surface concave.

Scales small, greatly crowded on back, breast and belly; largest along lower part of sides; 5 to 7 rather weak apical radiating striae; circuli basally as many as 90 on larger scales. Caudal base scaly. Pectoral and ventral without axillary scales.

Dorsal origin midway between front eye edge and caudal base; third simple ray $1\frac{7}{8}$ in head. Anal inserted well behind dorsal base or nearly midway between ventral and caudal base; first branched ray $2\frac{2}{3}$. Caudal well forked, $1\frac{2}{5}$ in head. Pectoral very nearly reaches ventral origin or about half way in ventral fins; length $1\frac{1}{2}$ in head. Ventral inserted well before dorsal, not quite reaching vent, length 2 in head. Vent close before anal.

Olivaceous-brown above, with dusky cloudings, side and lower surface paler. Fins brownish, paired fins little darker terminally. One example, 288 mm.

Distinguished from the next by its larger eye, proportions, etc.

Hypophthalmichthys nobilis (Richardson).

Head $3\frac{3}{5}$; depth 3; D. III, 7, I; A. III, 12, I; P. II, 18; V. I, 7; 125 tubular scales in lateral line to caudal base; 33 scales above lateral line, 17 below to anal origin; 58 predorsal scales; snout $3\frac{1}{2}$ in head measured from upper jaw tip; eye $7\frac{1}{3}$; maxillary $4\frac{1}{3}$; interorbital $2\frac{1}{4}$.

Body strongly compressed, deep; abdominal keel extending from isthmus to vent, scales not passing over; greatest depth at ventral origin. Caudal peduncle well compressed, long as deep or least depth $2\frac{3}{5}$ in head.

Head moderate, robust, well compressed, width $1\frac{9}{10}$ its length; upper profile with upper jaw slightly protruding upward. Snout broadly convex, obtuse, length half width. Eye subinferior, faces downward, hind edge at first third in head; $2\frac{2}{5}$ in snout or $3\frac{3}{4}$ in interorbital. Mouth with short gape, wide, closed jaws apparently about even. Maxillary little inclined from vertical, not reaching front nostril, largely covered by preorbital, its lower edge about level with eye centre. Edge of upper jaw firmly trenchant and mandible edge broadly obtuse. Tongue free, rounded, broad. Nostrils together, superior close before upper front eye edge well above eye; hind one slit-like and larger. Interorbital convex. Preorbital nearly long as eye; other suborbitals all narrow. Opercle with many fine radiating striae.

Gill-opening extends forward midway in head Gill-rakers annectant, as fine reticulations, about 70+280, equal gill-filaments on $\frac{4}{5}$ of eye. No pseudobranchiae. Isthmus narrow, slender, lower surface level.

Scales small, little smaller about edges of body, largest along lower side of trunk; 1 to 3 weak apical radiating striae; circuli fine. Caudal base scaly. Pectoral and ventral without axillary scales.

Dorsal origin midway between front eye edge and caudal base; third simple ray $1\frac{1}{2}$ in head; first branched ray $1\frac{3}{5}$. Anal inserted well behind dorsal base, or midway between ventral and caudal bases; first branched ray 2 in head. Caudal well forked, $1\frac{1}{5}$ in head. Pectoral not quite reaching ventral, $1\frac{2}{5}$ in head. Ventral inserted well before dorsal, reaches $\frac{2}{3}$ to anal, $1\frac{1}{10}$ in head. Vent close before anal.

Olivaceous-brown above, sides and below pale to whitish, with silvery tints. Back shows traces of greenish tints. Fins all brownish. One example, 324 mm.

LEUCISCINAE.

Fusania ensarca Jordan and Starks.

Head $3\frac{1}{2}$; depth $3\frac{3}{4}$; D. II, 7; A. III, 7; P. I , 9; V. I, 6; scales 27 in median lateral series from gill-opening to middle of caudal base and 3 more in latter; lateral line only as 5 tubes in first 5 scales, evidently well decurved; 9 scales transversely between dorsal and anal; 14 predorsal scales; snout $3\frac{7}{8}$ in head measured from upper jaw tip; eye $3\frac{1}{8}$; maxillary 3; interorbital 3.

Body compressed, moderately long, deepest at dorsal origin, edges all convexly rounded, except postventral which has slight median keel. Caudal peduncle well compressed, least depth $1\frac{1}{2}$ its length or $2\frac{2}{3}$ in total head length.

Head compressed, width half its length. Snout short, less than eye, length about $\frac{3}{4}$ its width. Eye with hind edge little behind middle in head length. Mouth terminal, lower jaw little protruded. Maxillary slender, reaches below front eye edge. No barbels. Nostrils together, close before upper front eye edge, hind one in slight crescent. Interorbital convex. Suborbitals narrow, leave cheek well exposed. Opercle smooth.

Gill-opening extends forward opposite hind edge of preopercle. Gill-rakers 2+8, lanceolate, slender, little less than gill-filaments. Pharyngeal teeth 1, 3, 5—4, 3, 0, hooked and apparently with slight grinding surfaces, edges entire.

Scales large, in even longitudinal rows, little smaller on breast and caudal base; with 5 to 7 apical radiating striae; circuli coarse, about 25.

Dorsal origin well behind ventral origin or about midway between hind pupil edge and caudal base; first branched ray $1\frac{7}{8}$ in head. Anal inserted little behind dorsal base or much nearer ventral origin than caudal base. Caudal well emarginated; $1\frac{1}{4}$? in head. Pectoral not quite reaching ventral, $1\frac{3}{5}$ in head. Ventral not reaching anal, $1\frac{3}{5}$ in head.

Pale brownish generally. Leaden longitudinal band concurrent with vertebral column, not ending in dark spot, though much darker in hind part of its course. Peritoneum shows through abdominal wall dull leaden-gray. Iris and sides of head with silvery tints. Fins all pale. One example, 30 mm.

The above agrees with the original account in most respects, except that it shows distinctly the presence of 3 rows of pharyngeal teeth. The slight median postventral keel is not mentioned by Jordan and Starks. This character suggests that *Phoxiscus kikuchii* Oshima[1] is synonymous. Doubtless its more developed lateral line is that of slightly older growth. *Phoxiscus* therefore becomes a synonym of *Fusania*.

Georgichthys scaphignathus Nichols.

Head $4\frac{1}{4}$; depth $3\frac{1}{4}$; D. II, 7; A. II, 6; scales 37 in lateral line to caudal base and 3 more in latter; 6 scales above lateral line, 6 below; 14 predorsal scales; head width $1\frac{1}{2}$; snout $1\frac{4}{5}$; eye $3\frac{3}{4}$; maxillary $3\frac{2}{5}$; interorbital 2. Four deep brown broad blotches

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[1] *Ann. Carnegie Mus.* XII, p. 225, 1910. Bokuselsi-kaku, Formosa.

on trunk, extending well down on sides. Edges of fins all narrowly pale, greater medial portions dusky. One example, 101 mm.

Exoglossops geei Fowler and Bean[1] is a synonym of the present species. Likewise *Exoglossops* falls as a synonym of *Georgichthys*.

ABRAMIDINAE.

Chanodichthys bramula (Valenciennes).

Head $4\frac{3}{5}$; depth $2\frac{1}{2}$; D. II, 7, I; A. II, 33, I; P. I, 16; V. I, 8; scales 49 in lateral line to caudal base and 3 more on latter; 11 scales above lateral line to dorsal origin, 8 below to anal origin; 46 predorsal scales; snout $3\frac{2}{3}$ in head; eye $4\frac{1}{2}$; maxillary 4; interorbital $2\frac{3}{5}$.

Body greatly compressed, deepest at dorsal origin; edges convexly rounded, except region between ventral base and anal origin, which furnished with median keel over which scales not passing. Caudal peduncle well compressed, length about $\frac{3}{4}$ its least depth, which 2 in head.

Head small conic, little compressed sides, but slightly approximated below; upper profile straight, oblique. Snout broadly conic, length $\frac{3}{5}$ its width. Eye with hind edge slightly before middle in head length; about equal to snout; $1\frac{2}{3}$ in interorbital; edge with narrow marginal adipose rim all around. Mouth small, well inclined and closed jaws about even in front. Maxillary small, not reaching eye or only about to front nostril, largely concealed and little expanded behind. No barbel. Edges of jaws firmly coriaceous, not trenchant. Nostrils large, together; hind one little larger and exposed as vertical crescent. Interorbital evenly convex. Opercle with fine radiating striae. Suborbitals narrow, infraorbitals only extend about $\frac{1}{4}$ over cheek.

Gill-opening extends forward about opposite hind eye edge. Gill rakers 6+12, short weak points, about $\frac{1}{4}$ of gill-filaments which slightly larger than eye. Pseudobranchiae little smaller than gill-filaments. Pharyngeal teeth 2, 5, 4-3, 5, 2, compressed, pointed, each with well-developed broad grinding-surface.

Scales smaller on median predorsal, breast, belly and caudal base; with 20 to 23 radiating apical striae; circuli fine; ventral axillary scale about $\frac{1}{4}$ of fin. Lateral line extends from upper edge of gill-opening to middle of caudal base, runs little low along side of caudal peduncle; tubes small, each short and extends over base of scale.

Dorsal origin about midway between front of eye and caudal base; first 2 rays spinous, second enlarged, longest $1\frac{1}{10}$ in head; first branched ray equals head. Anal origin little nearer caudal base than pectoral origin, below hind base of dorsal; first branched ray $2\frac{1}{10}$ in head, base long, nearly 3 in combined head and trunk. Caudal strongly forked, lobes slender and pointed, lower lobe longer and $3\frac{2}{3}$ in combined head and trunk. Pectoral $1\frac{1}{8}$ in head, not quite reaching ventral. Ventral inserted well before dorsal, reaches $\frac{7}{8}$ to anal, $1\frac{1}{6}$ in head. Vent close before anal.

[1] *Proc. U.S. Nat. Mus.* LVIII, p. 311, fig. 1 1920, Soo Chow.

Brown, paler below. Edges of scales narrowly darker. Fins all uniform brownish. Lower side of head and trunk with silvery reflections. One example, 295 mm.

Cultriculus kneri (Kreyenberg and Pappenheim).

Head 4; depth $4\frac{1}{2}$ to 5; D. III, 7, I; A. III, 11, I or 12, I; scales 47 in lateral line to caudal base and 2 more on latter; 8 scales above lateral line, 2 below; 21 to 23 predorsal scales; snout $3\frac{3}{5}$ in head measured from upper jaw tip; eye $3\frac{4}{5}$ to 4; maxillary $3\frac{4}{5}$ to $3\frac{7}{8}$; interorbital $3\frac{1}{5}$ to $3\frac{1}{4}$.

Body elongately fusiform, compressed, lower profile little more convex than upper. Caudal peduncle compressed, least depth $1\frac{2}{5}$ to $1\frac{3}{5}$ its length or $2\frac{1}{3}$ to $2\frac{3}{4}$ in total head length.

Head width $2\frac{1}{6}$ to $2\frac{1}{3}$ in its length. Snout conic, tip level with upper edge of eye; length $\frac{7}{8}$ to 1 in its width. Eye large, hind edge midway in total head length. Mouth large, lower jaw well protruded. Maxillary reaches opposite hind nostril, largely concealed by preorbital. Premaxillaries protractile. Jaw edges firmly coriaceous. Nostrils together, at last fourth in snout; hind one slit, twice length of front one. Interorbital broadly convex. Broad preorbital $\frac{2}{3}$ of eye; first suborbital about half width of second which nearly covers cheek; postorbital narrow, less in width than first suborbital. Opercle smooth.

Gill-opening forward not quite opposite hind eye edges. Gill-rackers 4+15, lanceolate, about $\frac{1}{4}$ of gill-filaments. Pseudobranchiae little less than gill-filaments. Pharyngeal teeth 2, 4, 4-5, 4, 2, hooked and some of larger with well-developed grinding-surfaces.

Scales in even longitudinal rows; with 13 to 25 apical radiating striae; circuli fine. Breast convexly rounded; belly from breast to vent with median keel over which scales do not pass. Lateral line complete, greatly deflected until just before ventral, then low along side of body and ascending midway along side of caudal peduncle; tubes simple, each extending about half way over scale exposure.

Dorsal origin midway between hind eye edge and caudal base, slightly nearer eye in smaller example; first branched ray $1\frac{1}{4}$ to $1\frac{2}{5}$ in head. Anal begins entirely behind dorsal base; first branched ray $2\frac{1}{6}$ to $2\frac{1}{5}$ in head. Caudal deeply forked, pointed lobes about long as head. Pectoral reaches $\frac{7}{8}$ to ventral, slightly longer than head. Ventral inserted well before dorsal or midway between snout tip and caudal base; $\frac{3}{5}$ to $\frac{2}{3}$ to anal; length $1\frac{1}{2}$ to $1\frac{2}{3}$ in head.

Back olivaceous-brown, sides and below silvery-white. Fins uniform brownish. Two examples, 122 to 153 mm.

Culter hypselonotus Bleeker.

Head $4\frac{1}{4}$; depth $4\frac{2}{3}$; D. II, 7; A. III, 21, I; scales 92 in lateral line to caudal base and 4 more on latter; 20 scales above lateral line, 10 below; 58 predorsal scales; snout $3\frac{3}{5}$ in head measured from upper jaw tip; eye $3\frac{3}{5}$; maxillary 3; interorbital 5.

Body elongate, strongly compressed, deepest at dorsal origin; edges all rounded convexly except trenchant post-ventral, over which scales not passing. Caudal peduncle strongly compressed, least depth half its length or $3\frac{1}{2}$ in total head length.

Head width $2\frac{3}{5}$ its length. Snout conic, width $1\frac{1}{8}$ its length. Eye with hind pupil edge midway in head length, long as profile of snout, greater than interorbital. Mouth large, terminally superior, mandible projecting, front tip level with upper edge of eye. Maxillary largely concealed by preorbital, vertically inclined, not quite reaching opposite front nostril, front edge with slight emargination. Nostrils together, front one at last third in head. Interorbital convex. Preorbital $\frac{3}{4}$ of eye, other suborbitals all narrow. Bones of head smooth.

Gill-opening forward opposite middle of eye. Gill-rakers 7 + 20, lanceolate, equals gill-filaments or 2 in eye. Pseudobranchiae long as gill-filaments. Pharyngeal teeth 2, 4, 5–5, 4, 2, with slight terminal hooks and moderate grinding surfaces. Isthmus narrow.

Scales small, cycloid, small along middle of back and breast; 5 or 6 apical; radiating striae; circuli moderate, rather fine apically.

Dorsal inserted about midway between hind maxillary edge and caudal base; second simple ray strongly osseous and but little less than first branched ray which $1\frac{1}{8}$ in head. Anal begins entirely behind dorsal base; first branched ray $1\frac{3}{4}$ in head. Caudal forked, upper lobe equals head. Pectoral almost reaches ventral, $1\frac{1}{10}$ in head. Ventral inserted well before dorsal, $1\frac{1}{5}$ to anal or $1\frac{2}{5}$ in head.

Brownish on back, sides and below silvery-white. Fins all pale brownish. One example, 195 mm.

Culter brevicauda (Günther).

Head 4 to $4\frac{1}{8}$; depth $3\frac{1}{2}$ to $3\frac{3}{4}$; D. II, 7, I; A. III. 26, I or 27, I; 62 to 64 scales in lateral line to caudal base and 3 or 4 more on latter; 12 or 13 scales above lateral line, 7 or 8 below; 40 to 42 predorsal scales; snout $3\frac{7}{8}$ to $4\frac{1}{5}$ in head from upper jaw tip; eye $4\frac{1}{8}$ to $4\frac{2}{5}$; maxillary $3\frac{3}{5}$ to $3\frac{3}{4}$; interorbital $3\frac{7}{8}$ to 4; head width $2\frac{1}{3}$ to $2\frac{2}{5}$. Snout conic, long as wide. Maxillary equals or slightly longer than snout. Interorbital conic. Scales with 7 to 10 weak apical radiating striae; 35 to 70 apical circuli. Dorsal inserted about midway between middle or front of eye and caudal base; first branched ray $1\frac{1}{3}$ in total head length; first branched anal ray 2; least depth of caudal peduncle equals its length or $2\frac{2}{5}$ to $2\frac{3}{4}$ in head; pectoral $1\frac{1}{5}$; ventral $1\frac{2}{5}$ to $1\frac{1}{2}$. Brownish above, sides and below with silvery reflections. Two examples, 177 to 185 mm

SERRANIDAE.

Siniperca chuatsi (Basilewsky).

Mandarin Fish.

Head $2\frac{1}{4}$ to $2\frac{1}{3}$; depth $2\frac{3}{5}$ to $2\frac{4}{5}$; D. XII, 14; A. III, 9; snout 4 in head measured from upper jaw tip; eye $5\frac{1}{4}$ to $6\frac{1}{3}$; maxillary $2\frac{2}{5}$; interorbital $6\frac{1}{3}$ to 8; head width $1\frac{3}{4}$ to 2. Least depth of caudal peduncle equals its length or $3\frac{1}{4}$ to $3\frac{2}{5}$ in total head length; fifth dorsal spine $2\frac{3}{5}$ to $2\frac{2}{3}$; eighth dorsal ray $2\frac{2}{3}$ to $2\frac{7}{8}$; second anal spine $2\frac{7}{8}$ to $3\frac{1}{2}$; second anal ray $2\frac{1}{5}$ to $2\frac{3}{5}$; pectoral $2\frac{1}{3}$; ventral $2\frac{1}{10}$ to $2\frac{1}{3}$. Dark streak from snout tip to eye and back along opercle edge above, then sloping up towards base of spinous dorsal. Blackish blotches in dorsals, anals and caudal, paired fins immaculate. Two examples, 153 to 207 mm.

OPHICEPHALIDAE.

Ophicephalus pekinensis Basilewsky.

Head $2\frac{4}{5}$ to 3; depth 5 to $5\frac{1}{2}$; D. 48 or 49; A. 33; scales 63 or 64 in lateral line to caudal base and 4 more in latter; 9 or 10 scales above lateral line, 9 or 10 below; 30 to 32 predorsal scales; snout $5\frac{1}{2}$ to $5\frac{2}{3}$ in head measured from snout tip; eye 7; maxillary $2\frac{3}{5}$ to $2\frac{3}{4}$; interorbital $5\frac{1}{4}$ to $5\frac{1}{2}$. Head width $2\frac{1}{10}$ to $2\frac{2}{5}$ in total head length. Median scales on top of head scarcely larger than those on occiput or sides of head. Least depth of caudal peduncle $3\frac{1}{2}$ to $3\frac{2}{3}$ in head; tenth dorsal ray $4\frac{1}{10}$ to $4\frac{2}{5}$; tenth anal ray $3\frac{3}{4}$ to $3\frac{7}{8}$; caudal $1\frac{4}{5}$; pectoral $2\frac{1}{4}$; ventral 3 to $3\frac{1}{3}$. Two examples, 180 to 182 mm.

Channa fasciata Steindachner.

Head $3\frac{1}{4}$; depth $5\frac{1}{2}$; D. 47; A. 28; scales 53 in lateral line to caudal base and 3 more on latter; 7 scales above lateral line and 8 below; 17 predorsal scales; snout $4\frac{1}{2}$ in head from upper jaw tip; eye $6\frac{1}{4}$; maxillary $2\frac{2}{5}$; interorbital $3\frac{1}{4}$. Head width $1\frac{3}{5}$ in its total length. Snout broadly convex, length half its width. Maxillary extends slightly beyond eye; expansion about $1\frac{2}{5}$ in eye. Lower jaw very slightly projects. Rather narrow bands of fine teeth in jaws; same large broad short teeth on palatines and few small ones across vomer. Interorbital broad and slightly convex. Gill-rakers as III and VI short low broad tubercles. Gill-filaments short, though much higher than tuberculate rakers or 2 in eye. Scales with 18 basal radiating striae, circuli fine; scales in top of head medianly much larger than on occiput and cheeks. Dorsal begins slightly behind base of pectoral; forty-sixth ray $2\frac{7}{8}$ in head. Anal origin about midway between front eye edge and caudal base; twenty-seventh ray $3\frac{1}{5}$ in head. Least depth of caudal peduncle $2\frac{2}{3}$ in head; caudal fin $1\frac{1}{3}$; pectoral $1\frac{3}{5}$.

Brown, paler to whitish on under surface of head and belly. Seven or eight blackish bars on back and down on sides, above slightly inclined forward. Black ocellus, with narrow pale border at base of upper caudal lobe on caudal peduncle. Sides of head and trunk with scattered bright pale spots, most distinct on lower half of body. Scattered pale spots on dorsal basally, otherwise fin brownish like other fins. Two dark streaks longitudinally in postocular, from hind edge of eye. Both dorsal and anal darker terminally than basally. One example, 133 mm.

ANABANTIDAE.

Polyacanthus opercularis (Linné).

Head 3; depth $2\frac{4}{5}$ to $2\frac{3}{5}$; D. XIV to XVII, 6; A. XVI to XXI, 11; scales 28 from shoulder to caudal base medianly; 14 scales transversely between dorsal anal origins ; 19 or 20 predorsal scales ; snout 4 to $4\frac{1}{5}$ in head measured from upper jaw tip ; eye 3 to $3\frac{1}{3}$; maxillary $3\frac{2}{5}$ to 4 ; interorbital 3 to $3\frac{1}{10}$. Head width $1\frac{3}{4}$ to 2 in its total length. Largely dull brown. Black opercular blotch distinct. Two examples, 49 and 50 mm.

In a note on this species by Fowler and Bean [1] by slipping a line of type ahead the last line on p. 316 should follow as the second line on p. 317.

TETRODONTIDAE.

Spheroides ocellatus (Osbeck.)

Head $3\frac{1}{8}$; depth contracted $3\frac{3}{4}$; D. V, 13 ; A. IV, 13 ; snout $2\frac{1}{4}$ in head ; eye $7\frac{2}{3}$; mouth width $3\frac{2}{5}$; interorbital 2 ; head width $1\frac{1}{4}$. One example, 122 mm.

GOBIIDAE.

Eleotris obscura Schlegel.

Head $2\frac{2}{5}$ to $2\frac{3}{5}$; depth $4\frac{1}{2}$ to 5 ; D. VIII-I, 9, 1 ; A. I, 8, 1 or I, 7, 1 ; scales 38 or 39 in median lateral series to caudal base and 4 to 6 more on latter ; 14 to 16 scales transversely ; 28 to 37 predorsal scales ; snout $3\frac{1}{2}$ to 4 in head ; eye 6 to 7 ; maxillary $2\frac{2}{5}$ to $2\frac{1}{2}$; interorbital $3\frac{1}{4}$ to 4.

Body elongate, depressed forward and trunk compressed. Caudal peduncle compressed, least depth $1\frac{1}{2}$ to $1\frac{2}{3}$ in its length or $3\frac{1}{3}$ to $3\frac{2}{5}$ in total head length.

Head width $1\frac{2}{3}$ to $1\frac{4}{5}$ its length. Snout broadly depressed, width $\frac{3}{4}$ its length. Eye impinging on upper profile, centre at first $\frac{2}{5}$ in total head length. Mouth large, lower jaw slightly protruded. Lips broad. Broad bands of strong, simple, conic teeth in jaws ; none on palate. Tongue truncate, entire and free in front. Maxillary reaches opposite eye. Front nostril in short tube about last fourth of snout ; hind one midway between front one and eye. Interorbital depressed, level, orbits little elevated each side. Gill rakers as 2 + 8 broad, short, asperous tubercles, greatly less than gill filaments, which $1\frac{3}{4}$ in eye.

Cheek with 3 horizontal close-set small bead like papillae, all joining below front edge of eye to give up short preorbital projection and uppermost sending up branch close along hind eye edge, giving line posteriorly towards upper end of gill-opening with another line along inner orbital margin of interorbital forward to groove of upper lip ; cluster of small papillae each side of snout tip, another above nostril each side of premaxillary processes and third about and below front nostril ; row of papillae vertically close behind preopercle edge on opercle ; also along preopercle groove another row extended forward over mandible, where another closely parallel follows forward till each side of symphysis ; cluster behind symphysis each side on chin.

Scales on body anteriorly small, becoming larger on caudal peduncle ; small scales on cheek and caudal base ; mandible, snout, lower surface of head, breast and middle of belly naked ; basal radiating striae 17 or 18 ; apical denticles, 41 + 41 ; circuli moderate.

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[1] *Proc. U. S. Nat. Mus.* LVIII, p. 316 (1920).

Fourth dorsal spine $2\frac{1}{2}$ in total length of head ; fourth dorsal ray $2\frac{1}{4}$ to $2\frac{4}{5}$; fifth anal ray $2\frac{2}{5}$ to $2\frac{1}{2}$; caudal $1\frac{1}{4}$ to $1\frac{2}{5}$; pectoral $1\frac{1}{2}$ to $1\frac{3}{5}$; ventral $1\frac{7}{8}$ to 2.

Brown above, paler below. Four obscure dark blotches on back, larger than interspaces. Sides of head and maxillary blotched with darker, also dark specks over most of head and chest. Dorsals blotched with dusky and large blotch in middle of spinous fin basally. Caudal with 4 or 5 cross bars, fewer on anal. Paired spotted with dusky. Three examples, 88 to 145 mm.

Gobius caninus Valenciennes.

Head $3\frac{1}{4}$; depth 5 ; D. IV-VI, 7 ; A. I, 7 ; P. 18 ; V. I, 5 : scales 30 in median lateral series to caudal base ; 9 scales transversely at soft dorsal and anal origins ; 10 predorsal scales ; snout $3\frac{1}{8}$ in head ; eye 3 ; maxillary $2\frac{4}{5}$; interorbital 4 in eye.

Body elongately fusiform, compressed, more so posteriorly and deepest at second dorsal origin. Caudal peduncle greatly compressed, least depth $2\frac{1}{2}$ its length or $2\frac{3}{4}$ in head.

Head compressed, little constricted above, width $1\frac{3}{4}$ in its length. Snout convex, length $\frac{3}{4}$ its width. Eye large, slightly impinging on upper profile, advanced, hind pupil edge nearly midway in head length. Mouth large, lower jaw little shorter. Maxillary well inclined, reaches about opposite pupil. Lips rather thick, fleshy. Teeth fine, in narrow band in each jaw. Tongue free, truncate, without median notch on front edge. Nostril as small simple pore midway on side of snout. Interorbital level, very narrow.

Gill-opening forward about midway in postocular region of head. Gill-rakers 2+5 lanceolate points, about $\frac{1}{3}$ of gill-filaments, which about equal interorbital.

Scales in even longitudinal series, crowded little on predorsal forward not quite to eye ; largest on caudal peduncle. Head, breast, prepectoral and fins, except caudal base, naked. Scales with 15 basal radiating striae ; apical denticles 15 + 19 ; circuli coarse. Row of close-set bead-like pores all along prepercle flange and posteriorly another vertical row over front of opercle and subopercle.

Spinous dorsal begins well behind pectoral origin ; second spine $1\frac{2}{3}$ in head. Soft dorsal origin about midway between hind eye-edge and caudal base ; first branched ray $1\frac{1}{5}$. Caudal rounded, slightly less than head. Pectoral with upper rays not free or silky ; $1\frac{1}{5}$ in head. Ventral disk long as pectoral.

Dull brown, little paler below. Sides with about 6 obsolete dusky blotches in median row. Fins dull brown. Dorsals and caudal with few faint cross streaks. Dark spot at pectoral axil above. One example, 34 mm.

MASTACEMBELIDAE.

Mastacembelus sinensis (Bleeker).

Head $6\frac{1}{6}$; depth $10\frac{1}{2}$; D. XXXIV, 64 ; A. III, 56 ; snout $3\frac{2}{5}$ in head ; eye $2\frac{1}{2}$ in snout ; maxillary $3\frac{1}{6}$ in head ; interorbital $2\frac{1}{2}$ in snout ; pectoral $3\frac{3}{4}$ in head. One example, 150 mm.

Mem. Asiat. Soc. Bengal, Vol. VI.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

REVISION OF THE JAPANESE SPECIES OF THE GENUS *CORBICULA*.

By B. PRASHAD, *D.Sc.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

REVISION OF THE JAPANESE SPECIES OF THE GENUS *CORBICULA*.

By B. PRASHAD, *D.Sc., Officiating Director, Zoological Survey of India.*

Pilsbry in 1907 published a monograph dealing with the Japanese species of the genus *Corbicula*, Meg. V. Mühlfeldt, but was not able to deal with a number of species from around Yokohama described by various European authors. His treatment of some of the other species was also questioned by Annandale when describing the molluscs of Lake Biwa. While on study leave in Europe in 1922 I took the opportunity of examining as many of the original series and types of Japanese species of the earlier authors as were available for examination, and the results of this study are here presented.

Of the various collections examined, I would specially note the types and other specimens in the British Museum (Natural History) London, the Berlin Museum, where the types of von Martens and most of the specimens named by Reinhardt are preserved, the Struttgart Museum containing the Clessin collection, and the Senckenberg Museum, Frankfurt-a-Main, containing the collections of the Deutsche Malakozoologische Gesselschaft, Boettger, Kobelt and Moellendorf. In addition I had the opportunity of studying the large collections in the Hamburg Museum, and the private collections of Dr. O. Reinhardt and H. Rolle of Berlin. For the courtesy shown me and the facilities given for studying the collections under their respective charges my best thanks are due to Dr. J. Thiele, Dr. O. Buchner, Dr. F. Haas, Dr. E. Degner and Mr. G. C. Robson. In addition I also had for my examination the collection made by the late Dr. N. Annandale in Japan in 1915, and I am greatly indebted to him for valuable suggestions made by him before his sad death.

After the paper was written I received a very valuable lot of paratypes and duplicates of Japanese Corbiculas from Dr H. A. Pilsbry of Philadelphia, and as a result of their examination I am able to fully confirm the results I had arrived at from my study of Dr. Pilsbry's descriptions and figures. I have to express here my great indebtedness to Dr. Pilsbry for his generosity in sending me these specimens for the Indian Museum.

Corbicula transversa von Martens.

1877. *Corbicula transversa*, von Martens, *Sitzungsber. Ges. Natur. Freunde Berlin*, p. 120.
1877. *Cyrena Yokohamanensis*, Sowerby, *Conch. Icon.* XX, pl. xii, fig. 55.
1878. *Corbicula ovalis*, Reinhardt (*nec* Prime), *Jahrb. deutsch. Malak. Ges.* V, p. 192 pl. v, fig. 5.
1878. *Corbicula transversa*, *C. Doenitziana*, Clessin, Martini and Chemn. *Conch.-Cab. Cyclädeen*, pp. 195, 197, pl. xxxviii, figs. 13, 14 and pl. xxxix, fig.4.
1879. *Cyrena transversa*, *Corbicula Doenitziana*, Kobelt, *Abh. Senck. Nat. Ges.* XI, pp. 440, 442, pl. xxi, fig. 2.

As a result of my examination of the type of *C. transversa* von Martens, *C. ovalis* Reinhardt and *C. doenitziana* Clessin, I have come to the conclusion that all of them belong to the same species. From the description and figure of *C. yokohamaensis* Sowerby, I am of opinion, that this species is also synonymous with von Martens's species. Unfortunately the type of this latter species, which ought to have been in the British Museum, London, could not, inspite of careful search, be found.

C. transversa, as Clessin rightly pointed out, has nothing to do with Prime's *C. ovalis*. Reinhardt was led to calling his own specimens, and those of von Martens's *C. transversa*, *C. ovalis* by comparison with a specimen in the Paetel collection labelled as such, and now preserved in the Berlin Museum. This specimen, which I have seen, is not a Japanese shell, and is, like many other specimens in the Paetel collection, wrongly labelled. Prime's unique type-shell of *C. ovalis* of unknown habitat, from the Cuming collection is preserved in the British Museum, London. It is a sub-equilateral shell with very fine ribs regularly arranged on the outer surface, and inspite of the eroded shell, it shows a fairly prominent umbo. The Yokohama shells on the other hand are markedly inequilateral with the posterior side drawn out into a beak-shaped area, irregularly ribbed, the ribs rather strong and much fewer in number; the interspaces much broader and the umbones somewhat depressed. Pilsbry[1] wrongly attributes this species to Clessin, and, quite ignoring Clessin's remarks, still considers it as being the same as Prime's *C. ovalis*.

This species is rather rare, and the only shells I have seen are the type-shells of von Martens and Clessin, and those referred to in Reinhardt's paper (*loc. cit.*).

Relationships:—The species is allied to *C. leana* Prime and *C. atrata* Reinhardt, but is easily distinguished by its shape, sculpture and the depressed umbones.

Corbicula sandai Reinhardt.

(Plate XXII, figs. 1–5.)

1878. *Corbicula Sandai*, Reinhardt, *op. cit.*, p. 187, pl. v, fig. 2.
1878. *Corbicula Sandai*, Clessin, *op. cit.*, p. 193, pl. xxxviii, figs. 11, 12.
1879. *Cyrena Sandai*, Kobelt, *op. cit.*, p. 437, pl. xx, fig. 3.
1907. *Corbicula sandai* and *C. viola*, Pilsbry, *Annot. Zool. Japon.* VI, pp. 157, 158, pl. vii, figs. 17–18, 7–10.
1916. *Corbicula sandai* and *C. viola*, Annandale, *Mem. As. Soc. Bengal*, VI, p. 51, pl. iii, figs. 10–12.

An examination of Reinhardt's type-shells and large numbers of shells of this species in various collections mentioned in the introduction and a paratype of *C. viola* Pilsbry has resulted in my uniting *viola* with *sandai*. Pilsbry's observations regarding the distinguishing characters of *C. viola* from *C. sandai* are not correct; his statement "differing from *C. japonensis* and *C. sandai* by the development of ribs over the whole median portion of the valves" is not bourne out either by Reinhardt's description or his type-shells. In the Latin diagnosis of the species he says "costis

[1] Pilsbry, *Annot. Zool. Japon.* VI, p. 154 (1907).

remotis regularibus obtecta" and further elaborates in the German description "Die Oberfläche der sehr dicken Schale ist mit regelmässigen, weit (über 1 mm.) von einander abstehenden, concentrischen, ziemlich stark hervortretenden Rippen bedeckt, (ca. 18), die in der Nähe des Hinterrands sich ziemlich plötzlich wie geknickt nach oben biegen." This character of the ribbing is quite constant in the large series examined by me, except that in some of the medium-sized shells the ribs become fainter just before bending upwards near the posterior margin; the shells in such examples appear as being nearly smooth in this region, but in no case have I found a specimen with the median portion of the valves smooth.

C. sandai is a very variable species. The young shells are nearly symmetrical, but become more and more asymmetrical with age. Young and medium-sized shells correspond in outline to the figures of Reinhardt, Pilsbry's figures 7 and 8, and Annandale's 10*b*, 11 and 12, older shells are like Pilsbry's figures 9, 10, 17 and 18, and the fully-grown shells resemble the one figured by Annandale as 10*a*. The largest shells which I have seen are still more asymmetrical. They are more elongate with a narrow, wing-like, drawn-out posterior margin, which is distinctly truncate. The sculpture on this region is of the type described by Pilsbry for his new species *C. viola*.

The colour of the shells is also very variable. Mostly the young shells are lemon-yellow in colour, but with age this is replaced by brown with only traces of yellow, while full-grown specimens are black. The nacre below the pallial line is shinning violet, and dull whitish grey above it, but in some shells it is of a light salmon colour with only streaks of violet shining through. The shells also vary to some extent in thickness.

Reinhardt's largest specimen was 24 mm. in length, that of Pilsbry's was 27 mm., while those collected by Dr. Annandale were as much as 31mm. long. The largest specimen before me from the Hamburg Museum, presented to the institution by Herr Lenz from collections made by him in 1896 near Sita, Omi, Lake Biwa, is 34 mm. long.

The type-series was obtained from near Kyoto, while the very large series examined by me were all collected at different places and times in Lake Biwa in the same district.

Relationships :—*C. sandai* is allied to *C. japonica* Prime, but is distinguished by the less shining periostracum, the different sculpture and the shape of the shells. Kobelt (*op. cit.*, p. 438) considered it to be allied to the Chinese *C. cyreniformis* Prime.

Fischer and Dautzenberg's[1] record of *C. sandai* from Indo-China does not appear to be correct as the species is true Japanese, being confined to the southern part of Japan proper, and not occurring north of Lake Biwa.

[1] Fischer and Dautzenberg, *Mission Pavie Indo-Chine* III, p. 442 (1904).

Corbicula japonica Prime.

(Plate XXII, figs. 6, 7.)

1864. *Corbicula Japonica*, Prime. *Ann. Lyc. Nat. Hist. New York*, VIII, p. 68, fig. 15.
1870. *Corbicula Japonica*, Prime. *Amer. Journ Conch.* V, p. 132.
1877. *Corbicula biformis*, Reinhardt, *Sitzungsber. Ges. Nat. Freunde*, p. 70.
1877. *Corbicula biformis*. von Martens, *id.* p. 119.
1878. *Corbicula biformis*, Reinhardt, *op. cit.*, p. 189, pl. v, fig. 3.
1878. *Corbicula Japonica* and *C. biformis*, Clessin, *op. cit.*, pp. 170. 194, pl. XXX, figs. 7, 8, pl. xxxviii, figs, 15, 16.
1879. *Cyrena biformis* and *Corbicula Japonica*, Kobelt, *op. cit.*, pp. 438, 443, pl. xxi fig. 3.
1907. *Corbicula Japonica*, Pilsbry *op. cit.*, p. 157.
1907. *Corbicula nipponensis* and var. *delicatula*, Pilsbry, *op. cit.*, pp. 159, 160, pl. vii figs. 3, 4, 11, 12.

In spite of the fact that Prime himself later[1] considered his *C. japonica* to be synonymous with Lamarck's *C. orientalis*, I have, after examination of Lamarck's type-specimen of the latter species, decided to consider it as a distinct species. The shape, sculpture and the colour are quite distinctive, and there seems to be no justification for uniting the two species. An examination of a very large series of shells from Osaka, Yeddo, Yokohama, Tokyo, Uweno Lake, and Sandai-gawa, Satsuma, Kiushiū Island has led me to the conclusion that Reinhardt's species *biformis* is also based on full-grown shells of *C. japonica*. The differences in the form and shape of the shells (for example Prime's description reads "shell is transversely oval, subtrigonal, nearly equilateral", while the shells described by Reinhardt are triangular rounded, with unequal sides, the anterior side being smaller than the posterior) disappear when a large series is examined. The sculpture also is very variable. The shining varnished epidermis is a very good diagnostic character of the species; it varies in colour from brown of various shades to black The nymphs are broad and nearly smooth while the double laterals of the right valve have the two teeth of the same size.

Prime's description of the species is based on young shells only, and does not correspond in all respects with his poor figures of the species. Reinhardt's description, on the other hand, is based on a large series of shells of all ages, and does not need any amplification.

Prime gave "Japonia" as the type-locality of the species, while Reinhardt's specimens probably came from Yedo. Von Martens collected large series of shells from Yokohama, and, as remarked above, the species seems to be widely distributed in Central Japan.

Relationships :—The species though allied to *C. orientalis* (Lam.) is quite distinct. Of the other Japanese species of *Corbicula* it is allied to *C. sandai* Reinhardt, but differs in theshape, sculpture, the shining varnishy epidermis, and the hinge of the shells.

1 Prime, *Ann. Lyceum Nat. Hist. New York*, X p. 188 (1874).

Corbicula leana Prime.

(Plate XXII, figs. 8–11.)

1864. *Corbicula Leana*, Prime, *op. cit.*, p. 68, fig. 14.
1870. *Corbicula Leana*. Prime, *op. cit.*, p. 132.
1877 *Cyrena* (*Corbicula*) *Leana*, von Martens (in pt.) *op. cit.* p. 119.
1878. *Corbicula pexata*, Reinhardt (*nec* Prime) *op. cit.*, p. 193, pl. v, fig. 6.
1878. *Corbicula Leana*, Clessin, *op. cit.*, p. 169 pl. XXX, figs. 5, 6.
1879. *Corbicula Leana*, and *Cyrena pexata*, Kobelt. *op. cit.*, pp. 443, 440, pl. XX, fig. 2.
1907. *Corbicula leana*, Pilsbry, *op. cit.*, p. 155. pl. vii, figs. 5, 6.
1907. *Corbicula orthodonta*, *id.*, *ibid.*, p. 156, pl. vii, figs. 1, 2.

With a paratype of *C. orthodonta* Pilsbry and a large series of specimens from Yokohama, Yodogawa, Osaka, Hinga, Kiushiu Island and Lake Biwa near Otsu, Omi, I can find no differences between Prime's *C. leana* and Pilsbry's *C. orthodonta*. Prime's description was apparently drawn up from medium-sized shells, while Pilsbry described his new species from large, full-grown shells. In the large series before me I have shells which correspond to both, and the shells of intermediate sizes bridge over the gap between them. In Reinhardt's collection I have also seen shells identified as *C. pexata* Prime and referred to under this name in his paper cited; these are also specimens of *C. leana*.

Prime's and Pilsbry's descriptions are very detailed, and I have nothing further to add to them.

Relationships:—*C. leana* Prime is closely allied to *C. fluminea* (Müll.), and is probably an insular form of this Chinese species, but the large size, the truncate posterior side and the sculpture are quite sufficient to distinguish it as distinct. Of the other Japanese species it is allied to *C. atrata* Reinhardt.

Pilsbry's inclusion of *C. reiniana* and *C. straminea* in the synonymy of this species is certainly incorrect.

var. **sadoensis** (Pilsbry).

(Plate XXII, figs. 12–14.)

1901. *Corbicula sadoensis*, Pilsbry, *Proc. Acad. Nat. Sci. Philadelphia*, p. 406.
1907. *Corbicula sadoensis*. Pilsbry, *op. cit.*, p. 158, pl. vii, figs. 15, 16.

With a paratype and large series of Pilsbry's *sadoensis* from Sado Island collected by Messrs. Faber and Voigt, in 1894 and now preserved in the Hamburg Museum, before me I find that this is only an insular variety of *C. leana*.

The external striations on which Pilsbry lays so much stress are very variable, and in shells from the same locality one finds shells having the striae either very densely arranged as in the type of *sadoensis*, or more widely apart as in *leana*. The umbones also are, in unworn specimens, similar, and so are the hinge and the nymphs. The shells are slightly smaller, and this along with the somewhat closer striae are the only two distinguishing characters of the variety. The species is somewhat variable in form, shells from the same locality often vary considerably in outline.

Corbicula atrata Reinhardt.

(Plate XXII, figs. 15, 16.)

1877. *Corbicula Leana*, von Martens (*nec* Prime, in Part) *op. cit.*, p. 119.
1878. *Corbicula fuscata* var. *atrata*, Reinhardt, *op. cit.*, p. 191, pl, v fig. 4.
1878. *Corbicula Martensii*, *C. Reiniana*, Clessin, *op. cit.*, p.196, pl. XXXVIII, figs. 17, 18, and pl. XXXIX, figs. 8, 9.
1879. *Cyrena Martensii* and *Corbicula Reiniana*, Kobelt, *op. cit.*, pp.. 441 442, pl. XX, fig. 5.

This species was considered by Reinhardt to be a variety of *C. fuscata* Prime. Clessin rightly considered it to be distinct from the Chinese species, but without reason gave it the new name *C. Martensi*. He also described another shell of this species under the name *C. Reiniana*.

Reinhardt's description is fairly complete and accurate except for the sculpture and I, therefore, append the following note. The young shells and half-grown individuals have the whole of the outer surface covered by rather fine, regular, concentric ribs, but in older specimens the sculpture becomes coarser and irregular.

Normal shells are thick, and have a fairly strong hinge, but in other cases both the hinge and the shell, apparently through corrosion due to the saline nature of the water in which they are found become much thinner. This is well shown in a lot of shells collected by Mr. Fredrick Stearns and bearing the label "Yokohama Tide-flats." This series was lent to me for study by Herr H. Rolle of Berlin, and is interesting in that it shows a gradation in the thick and thin nature of the shells and the hinge.

As noted above, both of Clessin's species—*martensi* and *reiniana*—are based on specimens of *atrata*, and I see no justification for altering the name.

Relationships :—The species is nearly allied to *C. leana* Prime, but is distinguished by the shells being much smaller and thinner, more equilateral and somewhat rounded-trigonal, with a much weaker and narrower hinge and the ribs on the surface much finer and more closely set.

Corbicula straminea, Reinhardt.

(Plate XXII, figs. 17, 18.)

1877. *Corbicula straminea*, Reinhardt, *op. cit.*, p. 70.
1878. *Corbicula straminea*, Reinhardt, *op. cit.* p. 186, pl. v. fig. 1.
1878. *Corbicula straminea*, Clessin, *op. cit.*, p. 193, pl. xxxviii, figs. 9, 10.
1879. *Cyrena straminea*, Kobelt, *op. cit.*, p. 439, pl. xx, fig. 4.

Pilsbry included this species doubtfully in the synonymy of *C. leana* Prime, because from the description and figures he could not find any material differences between it and the young shells of *C. leana*. I have examined shells of the type-series in the Berlin Museum and Dr. Reinhardt's collection, and have compared them with the specimen figured by Clessin and now preserved in the Struttgart Museum. I have examined also a large series from Fushimi, Yamashiro, Central Japan collected by Lenz in 1895 and presented to the Hamburg Museum, and find myself unable to agree with Pilsbry's conclusions. Unfortunately Reinhardt's figures of the species are very poor, and give a very wrong idea of the shape of the species. Kobelt's figure is only a copy of Reinhardt's and Clessin's figures, as is often the case, represent anything but the shells figured.

The shells of this species are not, as one would be inclined to believe from an examination of Reinhardt's figure, trigonal, but are much less higher than long; Reinhardt's description of "langlich rund" is much more applicable. This is the smallest of the Japanese Corbiculas, the largest specimen before me being only 14mm. long; Reinhardt's largest specimen was 16mm. long. The shell for this group of small-sized Corbiculas is rather stout, and has a fairly strong hinge. The surface is sculptured with strong, regular and concentric striae, which are separated by wide interspaces. I have nothing further to add to the original description of the species by Reinhardt.

Relationships:—The species, with its form *awajiensis*, is quite distinct from any other of the Japanese Corbiculas, and is probably related to some of the smallest forms found on the mainland.

var. **awajiensis** (Pilsbry).

(Plate XXII, fig. 19.)

1901. *Corbicula awajiensis*, Pilsbry, *op. cit.*, p. 407.

1907. *Corbicula awajiensis*, Pilsbry, *op. cit.*, p. 159, pl. vii, figs. 13, 14.

This form was figured in the second paper cited above, but Pilsbry did not add anything further to his first description. I have seen a paratype kindly sent me by Dr. Pilsbry and two other specimens from Awaji Island—the type-locality—and can see no reason for distinguishing it as specifically distinct from *C. straminea*. The only differences between the two are the slightly more elongate form and the little weaker hinge; the sculpture in both cases is identical. It is probably a dwarfed or depauperated form of *straminea*, and until more material is available for study I propose treating it as a distinct variety.

EXPLANATION OF PLATE XXII.

All the figures are from direct photographs of natural size except for figures 17-19, which are enlarged twice natural size.

Corbicula sandai Reinhardt.

FIG. 1.—Left valve of a young shell from Lake Biwa near Sita, Omi.

FIGS. 2–5.—Left valve of a series of shells from Lake Biwa near Sita, Omi showing the change in shape and growth.

Corbicula japonica Prime.

FIGS. 6, 7.—Left valves of 2 shells from Osaka, Central Japan.

Corbicula leana Prime.

FIG. 8.—Left valve of a middle-sized shell from Hinga, Kiushu Island.

FIGS. 9, 10.—Left valves of two full-grown shells from Lake Biwa, near Otsu.

FIG. 11.—Right valve of a medium-sized shell from Lake Biwa, near Otsu.

Corbicula leana var. **sadoensis** (Pilsbry).

FIGS. 12–14.—Right valves of 3 shells from Sado Island.

Corbicula atrata Reinhardt.

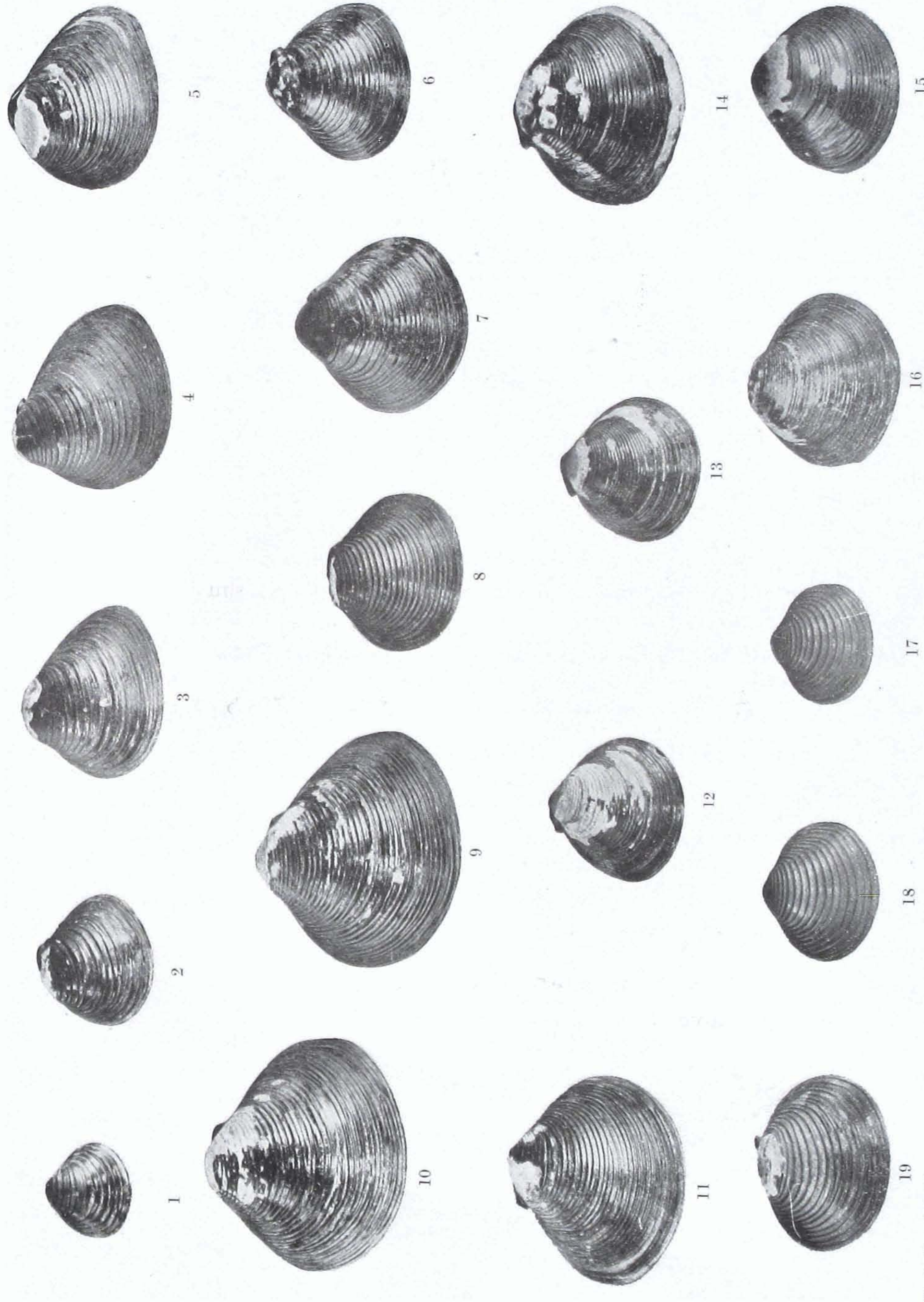
FIGS. 15, 16.—Right and left valves of two shells from Yokohama.

Corbicula straminea Reinhardt.

FIGS. 17, 18.—Left valves of two shells from Japan (without precise locality)

Corbicula straminea var. **awajiensis** (Pilsbry).

FIG. 19.—Left valve of a shell from Awaji Island.



JAPANESE CORBICULAS.

R. C. Mondul, photo.

[redacted]

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OF THE

ASIATIC SOCIETY OF BENGAL

VOL. VI, pp. 531—558, I–XII.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

EDITED BY N. ANNANDALE, D.Sc., F.A.S.B., F.R.S.

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(Concluding the Volume.)

PRINTED AT THE BAPTIST MISSION PRESS.
PUBLISHED BY THE ASIATIC SOCIETY OF BENGAL, 1, PARK STREET.
CALCUTTA.
1925.

Price Rs. 1-2.

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ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

THE AMPHIPODA OF TALÉ SAP.

By CHAS. CHILTON, *M.A., D.Sc., LL.D.*

CONTENTS.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

THE AMPHIPODA OF TALÉ SAP.

By CHAS. CHILTON, *M.A., D.Sc., LL.D., etc., Professor of Biology, Canterbury College, New Zealand.*

The Amphipoda from Talé Sap prove to be few in number, consisting of only eleven species. Of these nine are the same as those from the Chilka Lake. Only one species is described as new. Included in the report are two species from other localities, the first, *Grandidierella gilesi* from Patani River a short distance to the south on the same coast as Talé Sap, was taken also at Talé Sap, the second, *Colomastix pusilla*, from Port Weld on the other coast of the Peninsula was collected from this locality only.

The Isopoda which are being dealt with in a separate paper also show close resemblance to those of the Chilka Lake. The representatives of the two groups are thus of considerable importance in extending our knowledge of the geographical distribution of these species in the Far East.

I wish to thank Miss E. M. Herriott, M.A., assistant at the Canterbury College, Biological Laboratory, for preparing the drawings for this paper and for other valuable help.

Amphilochus brunneus Della Valle.

Amphilochus brunneus, Chilton, 1921, p. 524; 1923, p. 82.

Locality. Station 23. East Channel between Kaw Yaw and mainland. Two or three specimens, small.

I refer these specimens to *Amphilochus brunneus* because the carpal process of the second gnathopod does not reach to the palm, and both gnathopods agree with the description given by Della Valle. On the other hand, the molar of the mandible is well developed, as it is in the specimens that I have described from Chilka Lake and Port Jackson, New South Wales. I have discussed the relationships of some species of *Amphilochus* and *Gitanopsis* in the second paper mentioned above.

Colomastix pusilla Grube.

Colomastix pusilla, Stebbing, 1906, p. 207.

Locality. Port Weld, Perak, Federated Malay States. From crevices in a sponge, 6-1-16. Several specimens, about 3 mm. in length.

Among these specimens there were fortunately males and females, both agreeing well with the description given by Stebbing. Some of the females were ovigerous, but carried only two eggs which appeared very large as compared with the size of the animal.

This species appears to be distinguished from *C. brazieri* Haswell of Australia by having the two branches of the third uropods equal in length.

Walker has recorded *C. pusilla* from Ross Sea, in the Antarctic, especially mentioning that the branches of the uropod were of equal length, and that the specimen could not, therefore, be referred to *C. brazieri*.

Distribution. North Atlantic, Mediterranean, Malay, Antarctic (Ross Sea).

Perioculodes longimanus Bate and Westw.

Perioculodes longimanus, Chilton, 1921, p. 527.

Locality. Station 25. Ban Lein Chak on connecting Channel, Talé Sap. A few specimens.

These specimens appear to be quite the same as those from the Chilka Lake referred to this species.

Quadrivisio bengalensis Stebbing.

Quadrivisio bengalensis, Chilton, 1921, p. 537, text figure 6.

Localities. Station 1. Mouth of Patalung River, Talé Sap.
,, 11. Koh Si Hah, Talé Sap.
,, 32. Shore Collecting, Kaw Deng, Talé Sap.
,, 34. Shore Collecting, Kaw Yaw, Talé Sap.
,, 35. Shore Collecting, on mainland opposite Kaw Yaw, Talé Sap.

This species seems to be quite abundant at Talé Sap and was obtained from several different localities, the specimens presenting no appreciable difference from those of the Chilka Lake.

Distribution. Talé Sap; Chilka Lake; Zanzibar.

Niphargus chilkensis Chilton.

Fig. 1.

Niphargus chilkensis, Chilton, 1921, p. 531, fig. 4.

Localities. Station 35. Shore Collecting on Mainland opposite West end of Kaw Yaw at low tide, Talé Sap.
Station 36. Inner end Singgora Channel, Talé Sap.

Only one male specimen of this species was obtained, probably not fully developed, but it appears to be quite the same as the form found in the Chilka Lake.

Several specimens were taken which I feel pretty certain must be the female of this species, which had not been recognised before, as the specimens from the Chilka Lake were not numerous and those examined proved to be males. In these specimens the antennae are similar to those of the male, but the tuft of setae at the end of the second joint of the first antennae is wanting, the first gnathopod is slightly more slender than in the male, and does not show the special modification of the meral joint. The second gnathopod differs very considerably from the male, the carpus triangular, produced on the posterior side into a large rounded lobe partially overlapping the propod; the propod about as broad as the carpus, oval, palm oblique, not well defined. The third uropod has the two branches very unequal the larger one rather broad, only about twice as long as the peduncle, its terminal joint slender, the inner branch small and rather shorter than the peduncle.

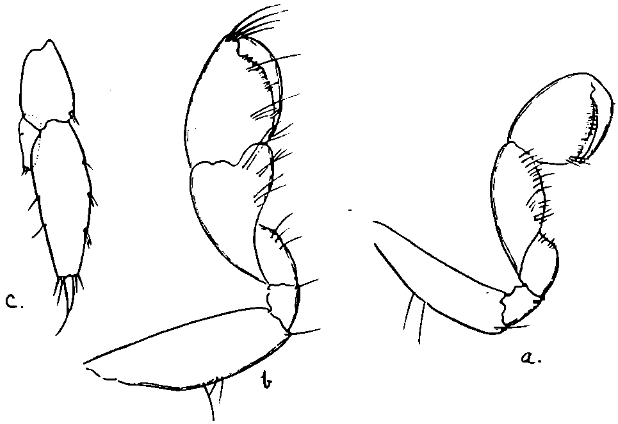

FIG. 1. *Niphargus chilkensis* Chilton.
a. First gnathopod of female.
b. Second gnathopod of female.
c. Third uropod of female.

Allied forms have been described from the Philippine Islands and from New South Wales in Australia.

Distribution. Chilka Lake, Talé Sap.

Talorchestia gracilis Dana.

Talorchestia gracilis, Dana, 1852–55, p. 861.
T. martensii, Chilton, 1921, p. 541.

Locality. Station 32. Shore Collecting at Kaw Deng inside mouth of Lake, Talé Sap.

One specimen, a male with greatly elongated second antennae.

Specimens received some time ago from Professor C. F. Baker of Los Banos, Philippine Islands, show that this species which was described in the Chilka Lake Amphipoda under the name of *T. martensii* is undoubtedly the same as Dana's *T. gracilis* originally described from Balabac Passage, Philippines. In the fully grown males the second antennae are greatly elongated and very slender; the form figured from the Chilka Lake was perhaps not quite fully developed, and its identity with Dana's species was therefore not recognised at the time.

Distribution. Talé Sap; Chilka Lake; Philippine Islands.

Hyale brevipes Chevreux.

Hyale brevipes Chilton, 1921, p. 545.

Locality. Station 5. ½ mile E.N.E. of mouth of Patalung R., Talé Sap. Two.
,, 11. Koh Si Hah, Talé Sap. Several.

Only a few specimens of this species were in the collection, but they seem undoubtedly to be the same as the forms examined from the Chilka Lake.

Distribution. Talé Sap; Indian Ocean.

Grandidierella megnae (Giles.)

Fig. 2.

Grandidierella megnae, Chilton, 1921, p. 548, fig. 10.
,, ,, Tattersall, 1922, p. 455, pl. 19, figs. 1-12.

Localities. Station 21. Across Channel from Singgora, Talé Sap. 4½ metres.
,, 29. Shore Collecting at Ban Hua Wang on Koh Yaio, Talé Sap.
,, 34. Shore Collecting at Kaw Yaw, Talé Sap.
,, 37. Inner end of Singgora Channel, Talé Sap.

This species was obtained from several localities and various stages were collected, but I think they are all referable to this species which is already known to occur in Madagascar and on the coasts of India and China. The second gnathopod

FIG. 2. *Grandidierella megnae* (Giles). First gnathopod of male, with portion more highly magnified.

of the male varies very much in appearance at different stages of its development and shows also some actual variation in form, thus the one represented in fig. 2 shows a number of teeth-like projections on the hinder margin of the propod which do not seem to be represented in the forms examined from the Chilka Lake.

Distribution. Madagascar, Bay of Bengal, Chilka Lake, Talé Sap. China.

Grandidierella gilesi Chilton.

Grandidierella gilesi, Chilton, 1921, p. 552.

Localities. Patani River, below town, Siamese Malay States. Water fresh, but probably subject to tidal influence. 5-2-16. One specimen.
Station 32. Shore collecting at Kaw Deng, just inside mouth of lake, Talé Sap.
,, 34. Shore collecting at Kaw Yaw, Talé Sap.

This species was obtained at two stations, in two case along with the preceding species. Various stages in the growth of the males were noticed, but none of them show any real distinction from the Chilka Lake forms.

Distribution. Talé Sap, Chilka Sap.

Photis longicaudata Bate and Westw. ?

Photis longicaudata, Chilton, 1921, p. 554.

A few small specimens similar to those obtained from the Chilka Lake.

Localities. Station 23. East Channel between Kaw Yaw and mainland.
,, 29. Shore Collecting at Ban Hua Wang on Koh Yaio.
,, 34. Shore Collecting at Kaw Yaw.

Podoceropsis insignis, sp. nov.

Fig. 3.

Locality. Station 27. Four specimens, length about 4 mm.

Male.—First antenna with the second joint of the peduncle longer than either the first or third; flagellum about as long as peduncle, of about 12 joints; accessory flagellum minute, one-jointed; under surface of the whole antenna densely haired. The second antenna much longer and stouter than the first, the last two joints of the peduncle subequal, the penultimate being slightly the broader; under surface of both densely fringed with long hairs and setules; flagellum about as long as peduncle, 13-jointed. First gnathopod with carpus and propod subequal, oval, palm oblique, slightly convex, not well defined, margin of palm and of the concave surface of the finger very minutely serrate. Second gnathopod with propod very large, as long as the basal joint, broad, palm not defined, but bearing two sharp teeth with a deep depression between them, and a rounded lobe near the base of the finger; finger very large, strongly curved, about as long as the propod with slightly projection on the inner side towards the base.

Female.—The female differs from the male in having the second antenna not modified, but only about as stout as the upper. First gnathopod similar to that of the male, but slightly more slender, second gnathopod with the carpus about half the length of the propod, triangular, propod narrow, oval, palm nearly straight, about half the length of the propod, not defined, margin of palm and concave margin of finger minutely serrate as in first gnathopod of male.

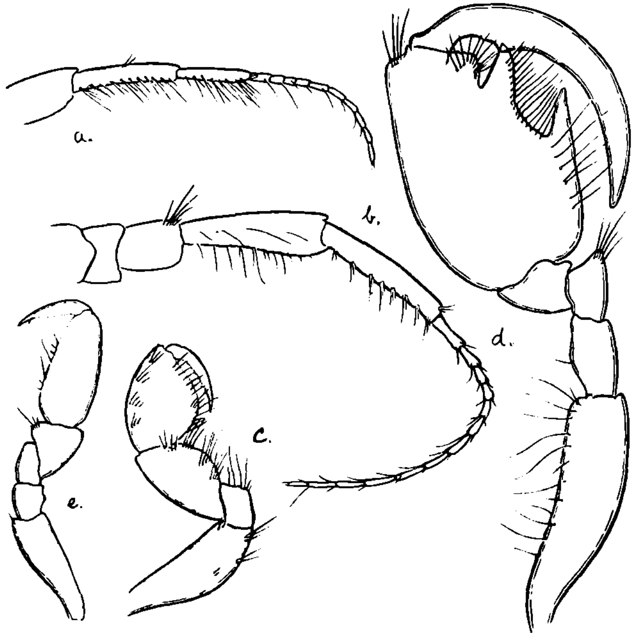

FIG. 3. *Podoceropsis insignis*, sp. nov.

a. First Antenna of male.
b. Second Antenna of male.
c. First gnathopod of male.
d. Second gnathopod of male.
e. Second gnathopod of female.

Corophium crassicorne Bruz.

Locality. Station 36. Fishing stake at inner end of Singgora Channel 2 metres in dense mud, Talé Sap.

Only one specimen was obtained. This may, possibly be the same as *C. triaeonyx* Stebbing,[1] but I can find no character of sufficient importance to distinguish it from the specimens found in New Zealand, Europe and elsewhere which I have identified with *C. crassicorne* Bruz. Since my paper referred to was written, I have also received specimens from Australia which seem to me to be the same. On the other hand Dr. K. Stephensen in a paper recently published distinguishes between the species *C. acherusicum* Costa, *C. bonnellii* M-Edw. and *C. crassicorne* Bruz., saying that the three are very often confused, but that the last is very easily recognisable, "the female with its very broad second antennae, and both sexes with the acute lateral lobes of the head (see Sars, 1895, pl. 220)." In the paper Dr. Stephensen describes the male of *C. bonnellii* M-Edw. which has been previously unknown.

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[1] Chilton, *Mem. Indian Museum*, V, p. 555 (1923).

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INDEX TO SCIENTIFIC NAMES.

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[*N.B.*—An Asterisk (*) preceding a name denotes a new subspecies or variety, a dagger (†) a new species, a double dagger (‡) a new genus; synonyms are printed in italics.]

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