RECORDS

of the

INDIAN MUSEUM

(A JOURNAL OF INDIAN ZOOLOGY)

Vol. I, Part I.

JUNE, 1907.

Calcutta:

PRINTED BY ORDER OF THE TRUSTEES OF THE INDIAN MUSEUM.
BAPTIST MISSION PRESS.

1907.

Price Two Rupees.

CONTRIBUTIONS TO THE FAUNA OF THE ARABIAN SEA, WITH DESCRIPTIONS OF NEW FISHES AND CRUSTACEA.

By R. E. LLOYD, *M.B., B.Sc., Capt. I.M.S., Surgeon Naturalist, Marine Survey of India.*

During the early part of 1906, the Indian Marine Survey Ship 'Investigator' proceeded from Muscat to Aden along the south coast of Arabia and returned by the same route. On both passages the trawl was used almost every day, so that ten hauls were obtained, three from less than 200 fathoms, and seven from about 500 fathoms or over. The results were for the most part good. Since this is the first time that the 'Investigator' or, I believe, any other ship has trawled in deep water along this coast, it seems well to publish a general account of the material obtained. So far it has only been possible to identify the Fish and Crustacea, but the greater part of the specimens fall within these two groups. The identification of species has been facilitated by the fine collection of types of Indian deep-sea Fish and Crustacea in the Indian Museum, Calcutta.

On the present collection, as a whole, the following observations may be made, and it is in these that its chief interest seems to lie :—

I. The number of new species met with is remarkably small considering that the ground was being investigated for the first time. Only two new Crustacea and five new Fish, all species of well-known genera, were obtained. Of these seven species five are from the three stations in less than 200 fathoms, while the seven stations in about 500 fathoms or over only contributed two new species, one Fish and one Crustacean.

II. The repeated occurrence of many of the species at several different stations is remarkable. Thus, of the seven deeper stations, one fish, *Bathygadus furvescens*, was found at four, while several species were found at three, although the seven stations were distributed irregularly along a line 1,000 miles or more in length.

III. The occurrence of the giant Isopod *Bathynomus giganteus* and the large bilaterally symmetrical Hydroid *Branchiocerianthus imperator* (which is here recorded from Indian seas for the first time) is noteworthy.

The details of the various stations are as follows :—

STATION No. 355.

Depth 492 fathoms. Lat. 21° 49 50″ N. Long. 59° 48′ 00″ E. Surface temperature 78° F. Bottom, green sandy mud with many Foraminifera.

The trawl came up with the iron beam bent nearly double and the net badly torn; in spite of this many things were obtained from the swabs and from the extreme end of the bag, which was intact.

FISH.

None obtained; any caught must have escaped.

CRUSTACEA.

Glyphocrangon investigatoris	(Three typical specimens).
Munida andamanica	(Several specimens. The spines at the side of the rostrum are about one-third of the length of the rostrum, *i.e.*, rather shorter than in the type; but this character is very variable).
Munidopsis trifida	(Several specimens).
,, *scobrina*	(Several specimens).
,, *spinihirsuta*, sp. n.	(Three small males. Described *postea*, p. 12).
Nematocarcinus cursor	(Several specimens).
Aristeus crassipes	(Two specimens).
Aethusa indica	(One specimen).

Entangled in the net were two specimens of a most beautifully reddish orange Hydroid, which were found to agree almost exactly with the form figured by Merk and subsequently by Miyajima, who named it *Branchiocerianthus imperator*. Similar specimens were subsequently obtained in deep water off the coast of Baluchistan; these will be more fully described elsewhere.

At this station a large number of Polychætes were obtained. Among them were representatives of the Chlorohæmid genera *Trophonia* and *Brada*, two Polynoids (one of which was a large blood-red species about three inches long) and a small Terebellid. A Eunicid contained in a branched parchment tube with openings at regular intervals was also present, and to this tube a colony of *Epizoanthus* was attached.

Besides these forms several bivalve Molluscs of the genus *Nucula*, probably *N. fultoni*, were taken, and the Asterid *Mediaster*, five species of Ophiurids and some Gorgonacea.

STATION No. 356.

Depth 156—200 fathoms. Lat. 17° 59′ 00″ N. Long. 57° 22′ 30″ E. Bottom temperature 58° F. Surface temperature 77° F. Bottom probably firm, hard sand; no sample was obtained in the sounding tube and the specimens in the trawl were all quite clean.

FISH.

Cynoglossus carpenteri	(Seven specimens of this Sole. They were distinctly bathybial in appearance, being of a very dark sepia colour and of a flabby consistency).

CRUSTACEA.

Paralia alcocki	(Over fifty specimens, including two giant males).

Many specimens of the Molluscs *Rostellaria delicatula* and *Pirula investigatoris*. These specimens are generally found together and have been met with several times in the Bay of Bengal and off the West Coast of India, always from about the 200-fathom line.

A small Eunicid in a sandy tube was also obtained.

STATION No. 357.

Depth 555 fathoms. Lat. 16° 51′ 00″ N. Long. 54° 55′ 00″ E. Bottom temperature 48·5° F. Surface temperature 78° F. Bottom, finely divided greenish mud.

FISH.

Lamprogrammus fragilis	(One specimen).
Bathygadus furvescens	(One specimen).

CRUSTACEA.

Nephropsis stewartii	(One specimen).
Aristeus crassipes	(Three specimens).
Sergestes bisulcatus	One specimen).
Lyreideus channeri	(One specimen).

Besides these species the following Polychætes were obtained :— two large specimens of *Hyalinœcia tubicola*, the tubes of which were about 10 inches in length, and an interesting genus which comes under the group Sigalionima and is perhaps *Thalanessa*. Its most remarkable features are a pair of large pink eyes and a median tentacle on the extensible proboscis. Also two small blood-red Polynoids, which were embedded in the outer skin of an Elasipod Holothurian. Also several large *Dentalia*, probably *D. magnificum* ; the empty shells of a species of *Cryptodon* ; a species of *Phormosoma*, and a Pennatulid with a quadrangular rachis bearing polyps on one side only.

STATION No. 358.

Depth 585 fathoms. Lat. 15° 55′ 30″ N. Long. 52° 38′ 30″ E. Bottom temperature 47·5° F. Surface temperature 77° F. Bottom, green sandy mud.

FISH.

Lamprogrammus fragilis	(Three specimens).
Bathygadus furvescens	(Two specimens).
Benthobatis moresbyi	(One small specimen of this interesting bathybial Torpedo, which is now found for the third time).

CRUSTACEA.

Bathynomus giganteus ..	(Two specimens, a female 7 inches long and a male 4 inches; generative apparatus was not present in either specimen. The female had undeveloped oöstegites to the thoracic legs. Both specimens were alive when taken from the trawl. The pleopods were covered with a small Barnacle described by Annandale under the name *Dichelaspis bathynomi* [*Ann. Mag. Nat. Hist.*, ser. 7, vol. xviii, July, 1906].)
Aristeus crassipes	(One specimen).
Acanthephyra armata	(One specimen).
Pandalus (Plesionika) martius	(One incomplete specimen).
Munida militaris	(Several specimens).
Nephropsis ensirostris	(One specimen).
Scalpellum bengalense	(Several specimens).

Many other species were obtained at this station, *e.g.*, Asterids of the genera *Persephonaster* and *Zoroaster*, with portions of a *Brisinga* including two central disks showing facets for sixteen arms. Also representatives of the Echinoid genera *Phormosoma* and *Cidaris* or allied genera. Also the Molluscs *Amussium* and *Cryptodon* and a shell-less Tectibranchiate form probably belonging to the genus *Neda*; Holothurians of the genus *Ankyroderma*; and a large quantity of a thin parchment-like tubing having the calibre of a crow's quill and bearing occasional side branches. These tubes contained an interesting little Polychæte of a dark green colour and resembling *Chætopterus* in its general form, but bearing two long white cephalic tentacles. Most probably it comes into the genus *Phyllochætopterus*.

STATION NO. 359.

Depth 674 fathoms. Lat. 14° 41′ 30″ N. Long. 50° 33 15″ E. Bottom temperature 47·2° F. Surface temperature 78° F. Bottom, green mud.

A poor result. One fine specimen of the Prawn *Acanthephyra armata*: the Molluscs *Amussium* and *Solenomya*: the Holothurian

Ankyroderma : the Polychætes *Hyalinœcia tubicola* and an interesting form with over one hundred segments all bearing elytra. This is probably a species of *Sigalion*.

STATION No. 360.

Depth 130 fathoms. Lat. 13° 36′ 00″ N. Long. 47° 32′ 00″ E. Temperature not taken. Bottom probably firm sand; no sample obtained in the tube and all the specimens quite clean.

FISH.

A good haul containing four new species.

Raia philipi, sp. n.	(One small male. Described in *Ann. Mag. Nat. Hist.*, ser. 7, vol. xviii, Oct. 1906).
Uranoscopus crassiceps	(Four specimens).
Peristethus adeni, sp. n.	(One specimen. Described *postea*, p. 8).
Bregmaceros macclellandi	(One specimen).
Lophius lugubris	(Three specimens).
,, *indicus*	(One specimen).
Bembrops caudimacula	(Many specimens. These are slightly unlike the type; the eye is relatively smaller and the cutaneous appendages on the lower end of the maxilla are longer).
Callionymus carebares	(Many specimens).
Narcine mollis, sp. n.	(Two specimens. Described *postea*, p. 8).
Solea umbratilis	(Many specimens. These seem darker in colour than the type and the skin feels rougher owing to the spinelets which project over the posterior border of the scales being somewhat stronger and more prominent).
Læops nigrescens, sp. n.	Many specimens. Described *postea*, p. 9).
Lepidotrigla spiloptera var. *longipennis* .	(Many specimens).

CRUSTACEA.

Only three species, but the numbers obtained were very large.

Palinurus angulatus	(Seventy-five of these Crayfish were taken. They made a loud creaking noise with their sound-producing apparatus as the net was hauled in).

Arctus orientalis (Forty-five specimens).
Mursia bicristimana (Twenty-five specimens).

The Molluscan genera *Persona* and *Pirula* (a species of the latter closely allied to *P. investigatoris*) and the Nudibranch *Pleurophyllidea* were represented. Also the Echinoderm genera *Cidaris*, *Clypeaster* and *Zoroaster*; and the Pennatulids *Veretillum*, *Umbellularia*, and *Pennatula*, all in great numbers.

STATION No. 361.

Depth 540 fathoms. Bottom temperature 51·5° F. Surface temperature 82° F. Bottom, green mud.

Another good result.

FISH.

Macrurus macrolophus (One specimen. Almost typical but differs from the type in two respects: (*a*) the spinelets on the scales are longer, (*b*) the barbels are minute. These two characters, the reduction of the barbels and the increase of the spinelets, are the principal features which separate *M macrolophus* from *M. investigatoris*. This specimen goes somewhat further along the same line of variation).
Dicrolene intronigra (One specimen).
Xenomystax trucidans (One specimen).
Bathygadus furvescens (Two specimens).
Saurenchelys tæniola (One specimen).
Diplacanthopoma squamiceps. sp. n. (Two specimens. Described *postea*, p. 10).
Lamprogrammus fragilis (Two specimens).

CRUSTACEA.

Glyphocrangon investigatoris (Two specimens).
Lyreideus channeri (Two specimens).
Pentacheles phosphorus (One specimen).
Pandalus alcocki (Many specimens).
Aristeus semidentatus (One specimen).
Homola megalops (Many specimens).
Aethusa indica (Five specimens).
Nephropsis stewartii (One specimen).
Munidopsis wardeni (Many specimens).
Munida andamanica (Three specimens).

The Echinoderm genera *Zoroaster* and *Phormosoma* are represented. Also the Mollusc *Verticordia eburnea* and a species of the Cephalopod genus *Cirrotheuthis.*

STATION No. 362.

Depth 480 fathoms. Lat. 13° 50′ 00″ N. Long. 48° 18′ 00″ E. Bottom temperature 55° F. Surface temperature 79° F. Bottom, green sandy mud.

FISH.

Macrurus macrolophus	(One specimen).
Bathygadus furvescens	(Two specimens).

CRUSTACEA.

Homola megalops	(Three specimens).
Lyreideus channeri	(One specimen).

Besides these, the Holothurian *Ankyroderma*, some Polychætes of the same species as were obtained at Station No. 357 (*Thalenessa* sp.), and several empty shells belonging to the genera *Cryptodon*, *Dentalium*, *Pleurotoma* (three species), *Solariella* and *Velutina.*

STATION No. 363.

Depth 810 fathoms. Lat. 14° 28′ 45″ N. Long. 50° 0′ 15″ E. Bottom temperature 43° F. Surface temperature 80° F. Bottom, green mud with many shells.

CRUSTACEA.

Aristeus crassipes.

Also the Holothurian *Ankyroderma* and the Polychætes *Hyalinœcia tubicola*, *Phyllochætoptorus* sp., and *Thalenessa* sp., the two latter belonging to the species obtained before. A large Schizonemertine, most probably of the genus *Cerebratulus*, was also taken.

STATION No. 364.

Depth 110 fathoms. Lat. 15° 8′ 30″ N. Long. 51° 52′ 15″ E. Bottom temperature 63·5° F. Surface temperature 80° F. Bottom, sandy mud.

CRUSTACEA.

Squilla investigatoris, sp. n	(Over five hundred specimens of this new species were the principal feature of this haul. Described *postea*, p. 10).

Also the Mollusc *Pirula investigatoris* and Pennatulids of the genera *Veretillum*, *Lituaria* and *Virgularia.*

DESCRIPTIONS OF NEW SPECIES.

FISH.

Peristethus adeni, sp. nov.

Br.r. 7 | a.D. 7 | p.D. 14 | v. 5 | P. 12 2 | L.L. 24 | L.tr. 4 | A. 14 |

The length of the præorbital process is equal to one-third of the distance between its extremity and the anterior border of the orbit. The præocular ridge has a prominent, finely serrated border; it ends behind in a sharp spine, which is nearly as long as the eye. The inner borders of the præorbital processes are parallel, their outer borders, if prolonged, would meet in front at an angle of 40° The præorbital processes therefore appear to converge. The length of each labial tentacle is equal to the width of the mouth.

The osseous plates between the ventral fins are unusually thick. The greatest length of each anterior ventral plate is equal to the greatest breadth of both combined. The greatest length of the posterior ventral plates is half that of the anterior ones. The greatest length, in both cases, is to one side of the middle line. A quadrangular portion of the posterior plates fits into a corresponding hiatus in the anterior plates. Throughout the length of the body, on either side, there are four rows of plates, each with a large spine shaped somewhat like a rose-thorn, their points curving backwards. The lowest row is much less conspicuous than the others.

There are large postorbital, occipital, post-temporal, and two opercular spines, a small upper and a large lower one, on either side. There is one small median spine, an orbit's length in front of the orbits.

The greatest height is one-fifth the total length. Total length of the single specimen 6½ inches : greatest length of the head three inches.

Colour—Reddish yellow; pectorals grey; dorsals tipped with black.

Habitat—Gulf of Aden; 130 fathoms.

Narcine mollis, sp. nov.

The vent is slightly nearer the anterior margin of the snout than the tip of the tail. The disc is evenly rounded, it is slightly broader than long. The margin of the flap formed by the confluent nasal valves is most prominent at the sides, unlike *N timlei*, the other Indian species. The whole quadrangular space which lies between the two nasal clefts is nearly as long as it is broad. In *N timlei* this space is three times as broad as it is long.

The anterior dorsal is slightly smaller than the posterior; it commences just behind the ventrals. The dorsal and caudal fins have blunt pointed ends and the folds of skin along the sides of the tail are obvious, but not prominent. The dorsal and ventral parts of the caudal fin are confluent.

The teeth are in 10 to 12 rows in both jaws; the front row has only 3 or 4 teeth; behind this the number gradually increases in succeeding rows up to about 16. The teeth of the front rows have triangular, flat surfaces; behind, the teeth bear a sharp median cusp.

The spiracle is immediately behind the eye and is the same size as the eye.

The electric organs seem well developed. The fish gave no perceptible shock to the hand and died soon after capture.

Round the margin of the disc, and along the sides of the tail, and over the snout, are the openings of mucous pores symmetrically arranged.

Consistency and general appearance distinctly bathybial.

Colour—Dark brown above, greyish brown below.

Habitat—Gulf of Aden; 130 fathoms.

Læops nigrescens, sp. nov.

D. 95 | A. 82 | C. 17. | P.d. & 5.13. | V.d. & s. 6. |

This species is closely allied to *L. guentheri* and *L. parviceps*. It differs from these in the following respects:—

It is bathybial in appearance. The pectoral fins are longer than the head. The head is $\frac{1}{4}$th the length without the caudal fin; the height without the fins is $2\frac{2}{3}$ in the total length. The pectoral fins are better developed on the left side; the length of the left pectoral is longer than the entire head in most specimens; it is never less than the length of the head. The left pectoral fin is much longer than the right, in some specimens nearly twice as long. The ventral fins are about equal: the left is in a line with the anal. The caudal fin is pointed, its length is 6 in the total. The length of the dorsal and anal fin rays are about equal and are about $2\frac{1}{2}$ in the body height. The lateral line forms a strong pectoral curve; the scales are small and deciduous. The snout is half the major diameter of the eye, the lower eye is in advance of the upper; the eyes are separated by a prominent ridge.

The major diameter of the eye is one-third the length of the head.

Teeth on the blind side only.

Vomer prominent, devoid of teeth.

Seven specimens, the longest $6\frac{3}{4}$ inches in length.

Colour—Left side dark sepia, with irregular patches of a darker sooty tone, fins nearly black. The colour resembles that of *Læops macropthalmatus* from 100 fathoms and differs widely from that of *L. guentheri* and *L. parviceps* from shallow water.

Habitat—Gulf of Aden; 130 fathoms.

Diplacanthopoma squamiceps, sp. nov.

Corresponds with the generic definition in the following respects :—the form and arrangement of the fins, of the teeth and the gills, in the number of the branchiostegals (8), in the absence of pseudobranchiæ and pyloric cæca, in the obscurity of the lateral line, and in the presence of radiating spines on the opercles. It differs from all known species in this important respect :—there are scales on the head as far forward as the posterior limit of the eyes and on the opercles and sides of the head as far forward as a line dropped vertically from the posterior border of the eyes. The head is much depressed and the eyes are close together and look upwards to a great extent, being separated by less than their diameter ; this gives the head a very different appearance from that of the other three known Indian species of the genus, in all of which the eyes are separated by about $1\frac{3}{4}$ times their diameter.

There are deep mucus pits on the head and in a semicircle below the orbits.

There are no pseudobranchiæ, but in the position of these organs there are two very short and slender filaments which are vestiges of this organ. I find that the type specimens of *D. riversandersoni* and *D. raniceps* have precisely similar vestiges. This seems to be a strong argument for including this new species under the genus Diplacanthopoma.

The length of the head is $3\frac{1}{2}$ in the total without the caudal fin.

The greatest height is one-sixth the length without the caudal fin.

The length of the eyes is a little less than the length of the snout.

There are 19 rays in the pectoral fins.

The filaments composing the ventral fins are composed of two rays.

The male has a well-developed penis.

Two specimens, a male and a female, both about five inches long.

Habitat—Off the S.-E. coast of Arabia ; 540 fathoms.

CRUSTACEA.

Squilla investigatoris, sp. nov.

Eyes large, consisting of two subequal lobes. The carneal axis is slightly oblique to, and a little longer than, the peduncular axis.

The rostrum s ovate, and is a little longer than its breadth at the base, without a carina, but with raised lateral margins.

There are five carinæ on the carapace ; the median one becomes flattened out and obscured anteriorly, and a little less than a rostrum's length behind the rostrum, it bifurcates. The anterolateral angles of the carapace bear spines, which do not extend as far forward as the level of the rostral base. The postero-lateral angles are smoothly rounded.

The first free thoracic segment bears two lateral spines, a long anterior one, curving downwards and forwards, and a short posterior blunter spine projecting transversely outwards ; there are no ventral spines. The second free thoracic segment has a bilobed lateral margin, the anterior lobe being smaller and more pointed than the posterior. The lateral margin of the third thoracic segment is also bilobed, the anterior lobe being much the smaller.

Excepting the first, each of the free thoracic segments bears four carinæ, the submedian ones being somewhat obscure All the abdominal segments excepting the last bear eight carinæ, the submedian pair are obscure. On the upper surface of the second to the fifth abdominal segments there is a small dorsal tubercle which is duplicated by a transverse groove. The lateral carinæ of the first to the sixth, the sublateral carinæ of the third to the sixth, and the submedian carinæ of the fifth and sixth end in a spine posteriorly.

The length of the telson is slightly greater than its breadth. The margin bears four large spines, a pair of submedian and a pair of sublateral ; anterior to each sublateral are two lesser marginal spines, the posterior of these bears a small tubercle at its hinder angle. Between the submedian spines there are 8 to 10 teeth. Between the submedian and sublateral spines on each side there are 9 to 10 teeth. The telson bears a mid-dorsal ridge and a ventral tuberculated keel, the dorsal ridge ends posteriorly in a spine, beneath which there are, in some specimens, two or three other spines. At the anterior end of the dorsal ridge is another blunt spine. The basal prolongation of the uropod is finely serrated on its inner margin, the inner division is by far the larger and bears a sharp spine in the middle of its outer edge. The proximal joint of the exopodite is a little longer than the distal and bears seven moveable spines on its outer border.

(Up to this point in the description this species differs only on minor points from *S. nepa*, *S. stridulans* and several other species.)

In the raptatorial claw we find the most distinctive feature. The dactylus bears about fifteen long, delicate curved teeth, the number varying within wide limits. The number of teeth in sixteen counted specimens was as follows :—13, 17, 16, 16, 14, 18, 14, 14, 13, 10, 16, 13, 17, 15, 17, 16.

This variation has no relation to sex. Not only does the number vary, but the length of the teeth and the amount of their curvature is very variable.

The opposing border of the propodite is finely serrated and bears three moveable denticles near its base ; of these the middle one is much the smallest. The carpus bears three stout blunt spines. The posterior angle of the claw, when folded up, does not reach as far as the posterior angle of the carapace.

Numerous specimens ; sexes about equally distributed.

Colour—Very variable, thorax and abdomen sand-colour with minute black spots; telson and uropodites show a blue-black colouration irregular in its distribution.

Habitat—S.-E. coast of Arabia, 110 fathoms.

Munidopsis spinihirsuta, sp. nov.

The length of the carapace is very slightly greater than the breadth.

The rostrum, which is less than half the length of the carapace, curves upwards especially towards the tip, is carinate and bears an obscurely serrated lateral margin. The entire upper surface and lateral margins of the carapace are covered with large pointed spines which curve forwards; these spines are arranged with some approach to symmetry; they are most numerous over the gastric regions; they all bear long hairs.

There are six spines on the posterior border of the carapace. The upper surfaces of the first three abdominal segments bear hairy spines.

The eyes are colourless, egg-shaped, and one-third the length of the rostrum; they are surmounted by a flat, curved, hirsute spine.

There is a small spine on the anterior border of the carapace between the eye and the second antenna forming the boundary of an orbit.

The chelipeds are nearly equal and are about as long as the entire body in the male (female unknown). The merus and carpus are covered with spines; there is a row of small spinules on the inner border of the propodite; the fingers are shorter than the palm. From the second to the fourth thoracic leg, the mero-, carpo-, and propodite are covered with small spines on their upper surfaces; the dactylus in these appendages is half the length of the propodite. There are no epipodites on the chelipeds or any of the walking legs. The basal joint of the peduncle of the second antenna has an external and an internal spine of equa size. The flagellum is about the same length as the body.

Three small males; largest $1\frac{1}{8}$ inch from telson to rostrum.

Colour—Pinkish yellow.

Habitat—Off S.-E. coast of Arabia; 492 fathoms.

RECORDS OF HEMIPTERA AND HYMENOPTERA FROM THE HIMALAYAS.

By C. A. PAIVA, *Entomological Assistant, Indian Museum.*

A considerable number of Hymenoptera and Hemiptera were added to the Indian Museum collection during the year 1906, and a very large proportion of these were collected in localities situated on the Himalayas and at their base. I propose to give a list of those species which I have been able to identify, restricting myself to Himalayan and sub-Himalayan specimens. This will not be a complete, or anywhere near complete, list of all the species which have up to the present been recorded from these tracts, but merely some of those which were collected during the years 1905 and 1906 by four or five collectors.

I have not attempted to deal with the Non-aculeate forms, the Ants and the Chrysididæ among the Hymenoptera; nor with the Jassids and other inconspicuous families among the Homoptera, nor the aquatic families of the Heteroptera.

The importance of such a list is that the localities are quite definite and that at least the approximate altitude of each place is given. The date of capture is also of interest.

The principal localities from which the collections have been received are :—

Mussoorie, 7,000 feet, May to August 1905.
Naini Tal, Kumaon, 6,400 feet, October 1906.
Bhim Tal, Kumaon, 4,500 feet, September 1906.
Chandragiri, Nepal, *circa* 8,000 feet, October 1906.
Nagarkote, Nepal, *circa* 6,000 feet, October 1906.
Thankote, Nepal, *circa* 5,000 feet, October 1906.
Pharping, Nepal, *circa* 5,000 feet, October 1906.
Katmandu, Nepal Valley, 4,500 feet, October 1906.
Soondrijal, Nepal Valley, October 1906.
Chitlong, Little Nepal Valley, October 1906.
Ghoom, 7,200 feet (Darjiling district), December 1906.
Darjiling, 7,000 feet, October 1905.
Sureil, 5,000 feet (Darjiling district), April 1905.
Pussumbing, 4,700 feet (Darjiling district), December 1906.
Tukvar, 4,500 feet (Darjiling district), October 1906.
Barnesbeg, 3,000 feet (Darjiling district), October 1906.
Kurseong, 5,000 feet (Darjiling district), May 1906.

Tindharia, 2,800 feet Rungtong, 1,400 feet Sookna, 540 feet Gyabari, 350 feet	All on the railway between Siliguri and Darjiling.	June 1906

Siliguri, at the foot of the Eastern Himalayas, June 1906.
Tonglu, 9,000 feet, September 1906.
Phallut, 11,000 feet, ,, ,,
Kalipokri, 10,000 feet, ,, ,,
Sandakphu, 10,500 feet, October 1906.
} All on the border between British Sikhim and Nepal.

The nomenclature adopted is that of Col. C. T. Bingham, as regards the Hymenoptera, and Mr. W. L. Distant, as regards the Hemiptera, in the "Fauna of British India and Ceylon." Specimens of numerous obscure Himalayan species not recorded in this list have been sent to these gentlemen for identification.

HYMENOPTERA.

FAM. MUTILLIDÆ.

Name.	*Locality.*	*Collector.*
Mutilla emergenda, Magr.	Siliguri, N. Bengal (June 1906)	J B. Richardson.
,, decora, Smith	Chandragiri, Nepal (Oct. 1906)	R. A. Hodgart.
,, funeraria, Smith	Katmandu, Nepal ,,	,,
,, antennata, Smith	Soondrijal, Nepal ,,	,,
,, ,, ,,	Mussoorie (May to Aug. 1905).	E. Brunetti.
,, subanalis, Magr.	Nagarkote, Nepal (Oct. 1906)..	R. A. Hodgart.

FAM. SCOLIIDÆ.

Tiphia incisa, Cam.	Darjiling (Oct. 1905)	E. Brunetti.
,, implicata, Cam.	Nagarkote Nepal (Oct. 1906)	R. A. Hodgart.
,, ,, ,,	Darjiling (Oct. 1905)	E. Brunetti.
,, compressa, Smith	,, ,,	,,
,, ,, ,,	Gowchar, Nepal (Oct. 1906)	R. A. Hodgart.
,, aureipennis, Bingh.	Darjiling (Oct. 1905)	E. Brunetti.
,, rufo-femorata, Smith	,, ,,	,,
Myzine dimidiata, Guér.	Siliguri (June 1906)	J B. Richardson.
,, madraspatana, Smith.	,, ,,	,,
,, anthracina, Smith	Soondrijal, Nepal (Oct. 1906)	R. A. Hodgart.
,, fuscipennis, Smith	Chitlong, Nepal (Oct. 1906) .	,,
Scolia quadripustulata, Fabr..	Siliguri, N. Bengal (June 1906)	J B. Richardson.
,, capitata, Guér.	,, ,, ,,	,,
,, rubiginosa, Fabr.	Chitlong, Nepal (Oct. 1906)	R. A. Hodgart.
,, aureipennis, Lepel.	Bhim Tal (Sept. 1906)	N. Annandale.
,, cyanipennis, Fabr.	Katmandu, Nepal (Oct. 1906).	R. A. Hodgart.
Elis thoracica (Fabr.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, annulata (Fabr.)	,, ,, ,,	,,
,, hirsuta, Sauss.	,, ,, ,,	,,
,, fimbriata (Burm.)	,, ,, ,, ..	,,
,, asiatica, Sauss.	Katmandu, Nepal (Oct. 1906).	R. A. Hodgart.
,, prismatica (Smith)	Darjiling (Oct. 1905)	E. Brunetti.

FAM. POMPILIDÆ.

Salius flavus (Fabr.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, sycophanta (Gribodo)	Katmandu, Nepal (Oct. 1906)	R. A. Hodgart.
,, fenestratus (Smith)	Nagarkote ,, ,,	,,

Name.	*Locality.*	*Collector.*
Pompilus pedestris, Smith	Siliguri, N. Bengal (June 1906)	J B. Richardson.
,, analis, Fabr.	,, ,, ,,	,,
,, maculipes, Smith	,, ,, ,,	,,
,, reflexus, Smith	,, ,, ,,	,,
,, ,, ,,	Chitlong, Nepal (Oct. 1906)	R. A. Hodgart.
	FAM. SPHEGIDÆ.	
Larra maura (Fabr.)	Siliguri, N. Bengal (June 1906)	J B. Richardson.
Notogonia subtessellata (Smith)	, ,, ,,	,,
,, tristis (Smith)	,, ,, ,,	,,
Liris aurata (Fabr.)	,, ,, ,,	,,
Trypoxylon intrudens, Smith	Mussoorie (May to Aug. 1905)	E. Brunetti.
Ammophila atripes, Smith	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, ,, ,,	Soondrijal, Nepal (Oct. 1906)	R. A. Hodgart.
,, punctata (Smith).	,, ,, ,,	,,
,, ,, ,,	Nagarkote ,, ,,	,,
,, ,, ,,	Chitlong ,, ,,	,,
,, ,, ,,	Bhim Tal (Sept. 1906)	N. Annandale.
,, ,, ,,	Mussoorie (May to Aug. 1905)	E. Brunetti.
Sceliphron violaceum (Fabr.) .	Siliguri (June 1906)	J B. Richardson.
,, ,, ,,	Tindharia ,,	,,
,, ,, ,,	Nagarkote, Nepal (Oct. 1906) .	R. A. Hodgart.
,, madraspatanum (Fabr.)	Katmandu, Nepal (Oct. 1906)	,,
,, ,, ,,	Siliguri (June 1906)	J. B. Richardson.
,, formosum (Smith)	Mussoorie (May to Aug. 1905)	E. Brunetti.
Sphex luteipennis, Mocs.	Katmandu, Nepal (Oct. 1906)	R. A. Hodgart.
,, nigripes, Smith	Soondrijal, ,, ,,	,,
Psen orientalis, Cam.	Mussoorie (May to Aug. 1905)	E. Brunetti.
,, ,, ,,	N. of Tonglu, 9,000′ (Oct. 1906)	I. H. Burkill.
Pemphredon fuscipennis, Cam.	Mussoorie (May to Aug. 1905).	E. Brunetti.
Stizus vespiformis (Fabr.)	Siliguri, N. Bengal (June 1906)	J B. Richardson.
,, prismaticus (Smith)	,, ,, ,,	,,
Cerceris instabilis, Smith	Soondrijal, Nepal (Oct. 1906)	R. A. Hodgart.
Oxybelus canescens, Cam.	Siliguri, N. Bengal (June 1906)	J B. Richardson.
Crabro buddha, Cam.	,, ,, ,,	,,
	FAM. EUMENIDÆ.	
Eumenes conica, Fabr.	Siliguri, N. Bengal (June 1906)	J B. Richardson.
,, esuriens, Fabr.	,, ,, ,,	,,
,, petiolata, Fabr.	,, ,, ,,	,,
,, affinissima, Sauss.	Mussoorie (May to Aug. 1905)	E. Brunetti.
Rhynchium brunneum (Fabr.)	,, ,, ,,	,,
,, ,,	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, hæmorrhoidale (Fabr.)	Tindharia ,, ,,	,,
,, argentatum (Fabr.)	Siliguri, N. Bengal ,,	,,
,, ,, ,,	Katmandu, Nepal (Oct. 1906)	R. A. Hodgart.
,, flavomarginatum, Smith	Siliguri, N. Bengal (June 1906)	J B. Richardson.
,, metallicum, Sauss.	,, ,, ,,	,,
Odynerus ceylonicus, Sauss.	,, ,, ,,	,,
,, punctum (Fabr.)	,, ,, ,,	,,
,, sichelii, Sauss.	,, ,, ,,	,,
,, sikhimensis, Bingh.	Soondrijal, Nepal (Oct. 1906)	R. A. Hodgart.

FAM. VESPIDÆ.

Name.	*Locality.*	*Collector.*
Polybia orientalis, Sauss.	Tindharia (June 1906)	J. B. Richardson.
,, ,, ,,	Bhim Tal (Sept. 1906)	N. Annandale.
,, ,, ,,	Chitlong, Nepal (Oct. 1906)	R. A. Hodgart.
,, ,, ,,	Soondrijal ,, ,,	,,
Icaria ferruginea (Fabr.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, marginata (Lepel.)	Tindharia (June 1906)	,,
,, variegata (Smith)	Siliguri, N. Bengal (June 1906)	,,
Polistes schach (Fabr.)	Bhim Tal (Sept. 1906)	N. Annandale
,, ,, ,,	Katmandu, Nepal (Oct. 1906)	R. A. Hodgart.
,, sagittarius, Sauss.	Siliguri, N. Bengal (June 1906)	J B. Richardson.
,, stigma (Fabr.)	,, ,, ,,	,,
,, maculipennis, Sauss..	Katmandu, Nepal (Oct. 1906)	R. A. Hodgart.
,, ,, ,,	Soondrijal ,, ,,	,,
,, ,, ,,	Mussoorie (May to Aug. 1905)	E. Brunetti.
,, adustus, Bingh.	Kurseong (May 1906)	N. Annandale.
,, ,, ,,	Soondrijal, Nepal (Oct. 1906)	R. A. Hodgart.
,, hebræus (Fabr.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
Vespa magnifica, Smith	Bhim Tal (Sept. 1906)	N. Annandale.
,, ,, ,,	Nagarkote, Nepal (Oct. 1906)	R. A. Hodgart.
,, cincta, Fabr.	Katmandu, Nepal ,,	,,
,, ,, ,,	Siliguri, N. Bengal (June 1906)	J B. Richardson.
,, basalis, Smith	Soondrijal, Nepal (Oct. 1906)	R. A. Hodgart.
,, flaviceps, Smith	,, ,, ,,	,,
,, ,, ,,	Mussoorie (May to Aug. 1905).	E. Brunetti.
,, auraria, Smith	,, ,,	,,
,, ,, ,,	Chitlong, Nepal (Oct. 1906)	R. A. Hodgart.
,, ,, ,,	Soondrijal, Nepal ,,	,,

FAM. APIDÆ.

Halictus lucidiusculus, Vachal	Bhim Tal (Sept. 1906)	N. Annandale.
Andrena mephistophelica, Cam.	,, ,,	,,
Nomia curvipes, Fabr.	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, thoracica, Smith	Soondrijal, Nepal (Oct. 1906)	R. A. Hodgart.
,, aurifrons, Smith	Katmandu ,, ,,	,,
,, ,, ,,	Nagarkote ,, ,,	,,
,, terminata, Smith	Sureil (April 1905)	A. Alcock.
Steganomus nodicornis, Smith	Mussoorie (May to Aug. 1903)	E. Brunetti.
Megachile conjuncta, Smith	Katmandu, Nepal (Oct. 1906)	R. A. Hodgart.
,, disjuncta (Fabr.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, monticola, Smith	Gowchar, Nepal (Oct. 1906)	R. A. Hodgart.
Ceratina sexmaculata, Smith	Mussoorie (May to Aug. 1905).	E. Brunetti.
Crocisa emarginata, Lepel.	Soondrijal, Nepal (Oct. 1906)	R. A. Hodgart.
Anthophora cingulata (Fabr.)	Katmandu, Nepal ,,	,,
,, ,, ,,	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, zonata (Linn.)	,, ,, ,,	,,
,, ,, ,,	Mussoorie (May to Aug. 1905).	E. Brunetti.
Xylocopa latipes (Drury)	Tindharia (June 1906)	J. B. Richardson.
,, tenuiscapa, Westw..	,, ,,	,,
,, acutipennis, Smith	Katmandu, Nepal (Oct. 1906).	R. A. Hodgart.
,, fenestrata (Fabr.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, iridipennis, Lepel.	,, ,, ,,	,,
,, æstuans (Linn.)	,, ,, ,,	,,

Name.	*Locality.*	*Collector.*
Xylocopa dissimilis, Lepel.	Nagarkote, Nepal (Oct. 1906)	R. A. Hodgart.
Bombus trifasciatus, Smith	Phallut, 11,000′ (Sept. 1906)	I. H. Burkill.
,, tunicatus, Smith	Mussoorie (May. to Aug. 1905)	E. Brunetti.
,, eximius, Smith	Sureil (April 1905)	A. Alcock.
,, flavescens, Smith	Katmandu, Nepal (Oct. 1906).	R. A. Hodgart.
,, ,, ,,	Soondrijal ,, ,,	,,
,, funerarius, Smith	Kalipokri, 10,000′ (Sept. 1906)	I. H. Burkill.
,, ,, ,,	N. side of Tonglu, 8,000—10,000′ (Sept. 1906)	,,
,, vallestris, Smith	Sandakphu, 10,500′ (Oct. 1906)	,,
,, hæmorrhoidalis, Smith	Bhim Tal (Sept. 1906)	N. Annandale.
,, ,,	Naini Tal (Oct. 1906)	,,
,, ,,	Mussoorie (May to Aug. 1905)	E. Brunetti.
,, orientalis, Smith	Tindharia (June 1906)	J B. Richardson.
,, ,, ,,	Chandragiri, Nepal (Oct. 1906)	R. A. Hodgart.
,, ,, ,,	Katmandu ,, ,,	,,
,, ,, ,,	Chitlong ,, ,,	,,
,, ,, ,,	Soondrijal ,, ,,	,,
Apis dorsata, Fabr.	Siliguri, N. Bengal (June 1906)	J B. Richardson.
,, ,, ,,	Mussoorie (May to Aug. 1905).	E. Brunetti.
,, indica, Fabr.	Tindharia (June 1906)	J. B. Richardson.
,, ,, ,	Chitlong, Nepal (Oct. 1906)	R. A. Hodgart.
,, ,, ,,	Pharping, Nepal ,,	,,
,, ,, ,,	Nagarkote, Nepal ,,	,,
,, ,, ,,	Katmandu, Nepal ,,	,,
,, ,, ,,	Naini Tal (Oct. 1906)	N. Annandale.
,, ,, ,,	Bhim Tal (Sept. 1906)	,,
,, ,, ,,	Mussoorie (May to Aug. 1905).	E. Brunetti.

HEMIPTERA.

FAM. PENTATOMIDÆ.

Coptosoma W. var. *a*. Montand.	Tindharia (June 1906)	J. B. Richardson.
,, nepalense, Westw.	Pussumbing (Dec. 1906)	H. H. Mann.
,, naziræ, Atk.	,, ,,	,,
Cantao ocellatus (Thunb.)	Tukvar (Oct. 1906)	,,
Pœcilocoris druræi (Linn.)	Katmandu, Nepal (Oct. 1906).	R. A. Hodgart.
,, purpurascens (Westw.)	Chitlong, Nepal ,,	,,
,, interruptus (Westw.).	Soondrijal ,, ,,	,,
,, rufigenis Dall.	Nagarkote ,, ,,	,,
Chrysocoris grandis (Thunb.)	Kurseong (May 1906)	N. Annandale.
,, fascialis (White)	Bhim Tal (Sept. 1906)	,,
Lamprocoris roylii (Westw.)	Kurseong (May 1906)	,,
,, ,, ,,	Bhim Tal (Sept. 1906)	,,
,, spiniger (Dall.)	Kurseong (May 1906)	,,
Stibaropus minor, Walk.	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
Dalpada affinis, Dall.	Bhim Tal (Sept. 1906)	N. Annandale.
,, ,, ,,	Katmandu (Oct. 1906)	R. A. Hodgart.
,, ,, ,,	Pussumbing (Dec. 1906)	H H. Mann.
,, ,, ,,	Mussoorie (May to Aug. 1905).	E. Brunetti.
,, versicolor (Herr.-Schaeff.)	Nagarkote, Nepal (Oct. 1906)	R. A. Hodgart.
Erthesina fullo (Thunb.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
Halys dentatus (Fabr.)	,, ,, ,,	,,

Name.	*Locality.*	*Collector.*
Asyla feæ, Dist.	Near Ghoom (Dec. 1906)	H. H. Mann.
Sciocoris indicus, Dall.	Mussoorie (May to Aug. 1905)..	E. Brunetti.
Æliomorpha lineaticollis (Westw.)	Sookna (June 1906)	J. B. Richardson.
Palomena viridissima (Poda).	Mussoorie (May to Aug. 1905).	E. Brunetti.
Eusarcocoris guttiger (Thunb.)	Sookna (June 1906)	J. B. Richardson.
Carbula indica (Westw.)	Kurseong (May 1906)	N. Annandale
,, ,, ,,	Mussoorie (May to Aug. 1905).	E. Brunetti.
Hoplistodera virescens, Dall.	Pussumbing (Dec. 1906)	H. H. Mann.
Plautia fimbriata (Fabr.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
Agonoscelis nubila (Fabr.)	Rungtong (June 1906)	,,
Tropicoris punctipes, Stål.	Nagarkote, Nepal (Oct. 1906)	R. A. Hodgart.
Priassus exemptus (Walk.)	Mussoorie (May to Aug. 1905).	E. Brunetti.
Canthecona furcellata (Wolff).	Bhim Tal (Sept. 1906)	N. Annandale.
,, ,, ,,	Chowbal, Nepal (Oct. 1906)	R. Hodgart.
Zicrona cærulea (Linn.)	Mussoorie (May to Aug. 1905)	E. Brunetti.
Eusthenes eurytus, Dist.	Gyabari (June 1906)	J. B. Richardson.
Aspongopus obscurus (Fabr.)	Sookna (June 1906)	,,
Megymenum severini, Bergr.	Kurseong (May 1906)	N. Annandale.
Urolabida histrionica (Westw.)	Bhim Tal (Sept. 1906)	,,
,, ,, ,,	Mussoorie (May to Aug. 1905)	E. Brunetti.
,, tenera, Westw.	Kurseong (May 1906)	N. Annandale.
,, uniloba, Stål.	,, ,,	,,
Urostylis gracilis, Dall.	,, ,,	,,
,, ,, ,,	Pussumbing (Dec. 1906)	H. H. Mann.
Urochela bimaculata, Dall.	Naini Tal (Oct. 1906)	N. Annandale.
,, ferruginea, Dist.	Katmandu, Nepal (Oct. 1906).	R. A. Hodgart.

FAM. COREIDÆ.

Elasmomia granulipes (Westw.)	Kurseong (May 1906)	N. Annandale.
,, ,, ,,	Rungtong (June 1906)	J. B. Richardson.
Ochrochira albiditarsis (Westw.)	Bhim Tal (Sept. 1906)	N. Annandale.
Homœocerus albiguttulus, Stål.	Soondrijal, Nepal (Oct. 1906)	R. A. Hodgart.
Notobitus meleagris (Fabr.)	Kurseong (May 1906)	N. Annandale.
,, marginalis (Westw.)	Pussumbing (Dec. 1906) ..	H. H. Mann.
Physomerus grossipes (Fabr.)	Kurseong (May 1906)	N. Annandale.
Acanthocoris scabrator (Fabr.)	Bhim Tal (Sept. 1906)	,,
,, ,, ,,	Katmandu, Nepal (Oct. 1906).	R. A. Hodgart.
Cletus punctulatus (Westw.)	Chitlong, Nepal ,,	,,
,, ,, ,,	Kurseong (Sept. 1906)	N. Annandale.
,, ,, ,,	Mussoorie (May to Aug. 1905).	E. Brunetti.
,, ,, ,,	Pussumbing (Dec. 1906)	H. H. Mann.
Leptocorisa varicornis (Fabr.)	,, ,,	,,
,, acuta (Thunb.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, ,, ,,	Katmandu, Nepal (Oct. 1906).	R. A. Hodgart.
Riptortus fuscus (Fabr.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
Serinetha augur (Fabr.)	Naini Tal (Oct. 1906)	N. Annandale.

FAM. LYGÆIDÆ.

Lygæus militaris (Fabr.)	Bhim Tal (Sept. 1906)	N. Annandale.
Graptostethus servus (Fabr.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, dixoni, Dist.	Chitlong, Nepal (Oct. 1906)	R. A. Hodgart.

Name.	*Locality.*	*Collector.*
Cænocoris marginatus (Thunb.)	Mussoorie (May to Aug. 1905).	E. Brunetti.
Nysius ceylanicus (Motsch.)	Kurseong (May 1906)	N. Annandale.
Malcus scutellatus, Dist.	Bhim Tal (Sept. 1904)	,,
Pamera pallicornis (Dall.)	Pussumbing (Dec. 1906)	H. H. Mann.
Peritrechus æruginosus, Dist.	Katmandu (July 1906)	J. Manners-Smith.
Dieuches leucoceras (Walk.)	Pussumbing (Dec. 1906)	H. H. Mann.
,, femoralis, Dohrn.	Kurseong (May 1906)	N. Annandale.
	FAM. PYRRHOCORIDÆ.	
Lohita grandis (Gray)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
Physopelta gutta (Burm.)	Katmandu (Oct. 1906)	R. A. Hodgart.
,, schlanbuschi (Fabr.)	Siliguri, N. Bengal (June 1906)	J B. Richardson.
Pyrrhopeplus pictus, Dist.	Kurseong (May 1906)	N. Annandale.
,, ,, ,,	Pussumbing (Dec. 1906)	H. H. Mann.
Dysdercu cingulatus (Fabr.)	Siliguri, N. Bengal (June 1906)	J B. Richardson.
,, evanescens, Dist.	Bhim Tal (Sept. 1906)	N. Annandale.
,, ,, ,,	Chitlong, Nepal (Oct. 1906) .	R. A. Hodgart.
	FAM. REDUVIIDÆ.	
Pygolampis unicolor, Walk.	Kurseong (May 1906)	N. Annandale.
Harpactor marginellus (Fabr.)	Siliguri, N. Bengal (June 1906)	J. B. Richardson.
,, ,, ,,	Mussoorie (May to Aug. 1906)	E. Brunetti.
Sphedanolestes pubinotum, Reut.	Kurseong (May 1906)	N. Annandale.
,, indicus, Reut.	Sureil (April 1905)	A. Alcock.
Epidaus atrispinus, Dist.	Kurseong (May 1906)	N. Annandale.
	FAM. CAPSIDÆ.	
Helopetlis theivora, Waterh.	Tukvar (Oct. 1906)	H. H. Mann.
Gismunda chelonia, Dist.	Kurseong (May 1906)	N. Annandale.
Deræocoris patulus (Walk.)	,, ,,	,,
	FAM. CICADIDÆ.	
Pycna repanda (Linn.)	Gowchar, Nepal (Oct. 1906)	R. A. Hodgart.
Tosena mearesiana (Westw.)	Tindharia (June 1906)	J. B. Richardson.
Cryptotympana intermedia (Sign.)	Kumaon, probably Bhim Tal (Sept. 1905)	L. L. Fermor.
Cryptotympana acuta (Sign.)	Bhim Tal (Sept. 1906)	N. Annandale.
Platylomia saturata (Walk.)	Naini Tal (Oct. 1906)	,,
Mata kama, Dist.	Nagarkote, Nepal (Oct. 1906).	R. A. Hodgart.
Gæana sulphurea (Hope)	Sureil (April 1905)	A. Alcock.
,, festiva (Fabr.)	,, ,,	,,
Scieroptera splendidula (Fabr.)	Rungtong (June 1906)	J. B. Richardson.
	FAM. FULGORIDÆ.	
Fulgora spinolæ, West.	Kurseong (May 1906)	N. Annandale.
,, clavata, Westw.	Tukvar (Oct. 1906).	H. H. Mann.
Lycorma delicatula (White)	Kalimpong, Darjiling (Nov. 06)	,,
Euphria aurantia (Hope)	Tukvar (Oct. 1906)	,,
Purohita arundinacea, Dist.	Barnesbeg ,,	,,

The following species do not appear to have been previously recorded from the Himalayas :—

HYMENOPTERA.

Mutilla emergenda, Magr.	recorded only from	Upper Burma.
Mutilla decora, Smith	,, ,,	Penang, Bhamo, Upper Burma, Rangoon Distr., Lower Burma.
,, subanalis, Magr.	,, ,,	Upper Burma.
Myzine madraspatana, Smith	,, ,,	S. India.
Scolia cyanipennis, Fabr.	,, ,,	Ceylon and Java.
Salius sycophanta (Gribodo)	,, ,,	S. India, Ceylon (?), Burma, Tenasserim.
Notogonia tristis (Smith)	,, ,,	Tenasserim to the Malay Region and Borneo.
Polybia orientalis, Sauss.	,, ,,	Pegu Hills, Tenasserim, China.
Halictus lucidiusculus, Vachal	,, ,,	Karen Hills, Burma.
Ceratina sexmaculata, Smith	,, ,,	Hong Kong, Upper Burma, Tenasserim and Eastern Siamese Malay States.

HEMIPTERA.

Asyla feæ, Dist.	recorded only from	Burma ; Kakhyen, Kauri.
Priassus exemptus (Walk.)	,, ,,	Naga Hills, Tenasserim, Mt. Mooleyit.
Notobitus meleagris (Fabr.)	,, ,,	Nilgiri Hills, E. Siamese Malay States, China and several islands in the Malay Archipelago.
Serinetha augur (Fabr.)	,, ,,	Calcutta, Bombay, Madras, Ceylon, Assam, Upper Tenasserim, West Yunnan, the Malay Peninsula and Hainan.
Graptostethus dixoni, Dist.	,, ,,	Bombay ; Khandela.
Cryptotympana acuta, Sign.	,, ,,	Bhutan Duars, Java, Borneo, Lombok, Philippines, Timor.
Lycorma delicatula (White)	,, ,,	Assam, Sibsagar (?) ; China.

FURTHER NOTES ON INDIAN FRESH-WATER ENTOMOSTRACA

By ROBERT GURNEY.

In a short paper published last year in the *Journal of the Asiatic Society of Bengal*, I gave an account of certain Entomostraca in the collection of the Indian Museum. Dr. Annandale has been good enough to send me further collections of freshwater Entomostraca, and it was my intention to continue to work at the Indian species from material supplied by him. Unfortunately pressure of work and other engagements prevents me from fulfilling my part of the task, so that I think it advisable to communicate now the results so far achieved.

The material with which the following notes are concerned consists of twelve bottles containing collections made in Lower Bengal and Chota Nagpur. As my work may subsequently be incorporated in the extended study on the Bengal tanks which, I understand, Dr. Annandale has in hand, I think it best to give the full list of the contents of each sample, together with those of certain others received before, and already mentioned in my previous paper.

Feb. 5th, 1907.

LIST OF THE COLLECTIONS.

1. CALCUTTA—Museum (*Kyd Street*) tank. Deep at centre, shallow at sides ; stiff clay bottom ; much vegetation. April 5, 1905.
   Simosa elizabethæ (King) (abundant).

2. CALCUTTA—Museum tank. Jan. 21, 1906.
   Simosa elizabethæ (King) (rare).
   Scapholeberis kingi, Sars (abundant).
   Cyclops leuckarti, Claus (common).
   ,, *prasinus*, Fischer (common).
   ,, *phaleratus*, Koch (one specimen).

3. CALCUTTA—Aquarium in the Museum. Oct. 16, 1904.
   Stenocypris malcolmsoni, Brady

4. The same. April 10, 1905.
   Ceriodaphnia rigaudi, Richard.

5. PORT CANNING, Ganges delta—Edge of a brackish pond, water very dirty ; vegetation scanty. Jan. 29, 1906.
   Ceriodaphnia rigaudi, Richard.
   Cyclops leuckarti, Claus.

6. PORT CANNING, Ganges delta—Edge of a small brackish pond. *Naias* and *Lemna* fairly abundant. Jan. 28, 1906.
   - *Ceriodaphnia rigaudi*, Richard (a few; some females with ephippia; no males).
   - *Cyclops leuckarti*, Claus (abundant).
   - Also many Amphipods, a few Ephemerid larvæ and *Corixa*.

7. CALCUTTA—Museum tank. Feb. 8, 1906.
   - *Simosa elizabethæ* (King) (common).
   - *Ceriodaphnia rigaudi*, Richard (abundant).
   - *Scapholeberis kingi*, Sars (abundant; some females with ephippia).
   - *Dunhevedia crassa*, King (one specimen).
   - *Cyclops prasinus*, Fischer (a few).
   - *Diaptomus contortus*, n. sp. (common).
   - *Cyclops leuckarti*, Claus.

8. CALCUTTA—Museum tank. Nearly dried up at edges. Feb. 20, 1906.
   - *Diaphanosoma*, sp.
   - *Simosa elizabethæ* (King) (common).
   - *Ceriodaphnia rigaudi*, Richard.
   - *Scapholeberis kingi*, Sars (abundant; some females with ephippia).
   - *Chydorus globosus*, Baird, var. *sculptus*.
   - *Cyclops leuckarti*, Claus.
   - ,, *prasinus*, Fischer.
   - *Diaptomus contortus*, n. sp.
   - *Atya*, sp.

9. CALCUTTA—Museum tank. March 3, 1906.
   - *Diaphanosoma*, sp.
   - *Simosa elizabethæ* (King).
   - *Ceriodaphnia rigaudi*, Richard (common).
   - *Scapholeberis kingi*, Sars (common).
   - *Cyclops leuckarti*, Claus.
   - *Diaptomus contortus*, n. sp.

10. CALCUTTA—Museum tank. Washings of *Spongilla carteri*.
    - *Macrothrix goeldi*, Richard.
    - *Cyclops fimbriatus*, Fischer.
    - ,, *varicans*, Sars.

11. CALCUTTA—Small artificial tank on the Maidan; vegetation rather scanty. Feb. 23, 1906.
    - *Scapholeberis kingi*, Sars (one specimen).
    - *Cyclops leuckarti*, Claus.
    - ,, *serrulatus*, Fischer.

12. CALCUTTA—Tank on the Maidan. Feb. 26, 1906.
    - *Lynceus guttatus* (Sars) (rare).
    - ,, *rectangulus* (Sars) (rare).

Cyclops leuckarti, Claus (common).
,, *varicans*, Sars (rare).
,, *prasinus*, Fischer (a few).
Diaptomus contortus, n. sp. (several young, but only two adults).
Pseudodiaptomus lobipes, n. sp. (common, but all females).
Caridina, sp.

13. CALCUTTA—The Zoological Gardens A small tank with little vegetation ; shallow.
Simosa elizabethæ (King) (one specimen).
Ilyocryptus longiremis, Sars (?) (one decayed young specimen).
Lynceus rectangulus, Sars (common).
Leydigia acanthocercoides, Fischer (?) (one cast skin).
Cyclops leuckarti, Claus.
,, *prasinus*, Fischer (common).
,, *varicans*, Sars (rare).
,, *serrulatus*, Fischer (rare).
Pseudodiaptomus lobipes, n. sp. (common, but only one male).

14. CHAKRADHARPUR, CHAIBASSA DISTRICT, CHOTA NAGPUR—Swamp without shade ; not many plants. March 3, 1906.
Diaphanosoma sarsi, Richard (one specimen).
Simosa elizabethæ (King) (common).
Macrothrix triserialis, Brady (a few).
,, *tenuicornis*, n. sp. (one specimen).
Camptocercus australis, Sars (one specimen).
Lynceus cambouei, De Guerne and Richard (two specimens).
Alonella excisa (Fischer) (rare).
Chydorus sphæricus (O. F. Müller) (rare).
Cyclops oithonoides, Sars (rare).
,, *leuckarti*, Claus.
,, *varicans*, Sars (rare).
,, *serrulatus*, Fischer (rare).
Diaptomus doriai, Richard.
,, *cinctus*, n. sp.
,, *pulcher*, n. sp.
,, *strigilipes*, n. sp.

15. CHAKRADHARPUR—Pool in small stream, in open among water plants ; pool small, shallow, without shade. March 3, 1906.
Cyclops leuckarti, Claus.
,, *serrulatus*, Fischer.

16. CHAKRADHARPUR—Large, shallow tank without shade ; weeds abundant. March 6, 1906.
Diaphanosoma sarsi, Richard (common).
Simosa elizabethæ (King) (abundant ; some females with ephippia).
Ceriodaphnia rigaudi, Richard.
Macrothrix triserialis, Brady (rare).
,, *tenuicornis*, n. sp.

Leydigia australis, Sars (two specimens).
Alonella excisa (Fischer).
Chydorus sphæricus (O. F. M.).
Cyclops serrulatus, Fischer.
,, *diaphanus*, Fischer
Diaptomus doriai, Richard (common).
,, *contortus*, n. sp. (rare).
,, *cinctus*, n. sp. (rare).
Cyclestheria hislopi (Baird) (one specimen).
Stenocypris malcolmsoni (Brady).

17. CHAKRADHARPUR—The same as preceding. March 5, 1906.
Diaphanosoma sarsi, Richard.
Simosa elizabethæ (King).
Ceriodaphnia rigaudi, Richard.
Chydorus sphæricus (O. F. M.).
Cyclops leuckarti, Claus.
Diaptomus contortus, n. sp.
,, *blanci*, De Guerne and Richard.
,, *similis*, Baird.

LIST OF SPECIES.

PHYLLOPODA.

1. *Cyclestheria hislopi* (Baird).

In my first paper I recorded a single specimen of this interesting species from a tank in Calcutta. Another was found in a collection from Chakradharpur (No. 16).

CLADOCERA.

2. *Diaphanosoma sarsi*, Richard.

Chakradharpur (Nos. 14, 16, 17).

A species widely distributed in the Oriental Region, and also recorded from New Guinea and Brazil.

3. *Diaphanosoma*, sp.

Some specimens taken in the Museum tank (Nos. 8, 9).

This is a species which has certain resemblances to *D. singalensis*, Daday, but which appears to be distinct. I prefer for the present to leave it undetermined.

4. *Ceriodaphnia rigaudi*, Richard.

This species occurs in several collections from Chakradharpur and Calcutta (Nos. 6, 7, 8, 9, 16, 17).

5. *Simosa elizabethæ* (King).

This species appears to be the commonest Daphnid in the localities in which the collections were made, though *Ceriodaphnia* *rigaudi* is a good second. (Occurs in collections Nos. 7, 8, 9, 13, 14, 16, 17.)

6. *Scapholeberis kingi*, Sars.

Abundant in the Museum tank in February and at that time a few of the females bore ephippia. In a collection taken in March the numbers had somewhat decreased. (Nos. 7, 8, 9, 11.)

So far this species had only been found in Sumatra and Siam.

7. *Macrothrix triserialis*, Brady.

A few specimens taken at Chakradharpur (Nos. 14, 16).

The ventral margin of the shell is closely serrated anteriorly, but posteriorly the teeth are arranged, as described by Prof. Brady (1886), in groups of three. These grouped teeth are of a somewhat remarkable nature. They appear to me to be of the nature of small hyaline scales overlapping each other somewhat in the manner of a hood. The sculpture of the shell is not alluded to by Prof. Brady, but in the figures given by Prof. Daday (1898), the shell is shown covered with lines enclosing lozenge-shaped areas. In my specimens the shell is marked with conspicuous ridges which do not intersect at all, though they may bifurcate here and there. The form of the upper lip, with its transverse ridges, is characteristic (fig. 21).

8. *Macrothrix tenuicornis*, n. sp.

Carapace of the female nearly round in outline, the posterior angle very slight or altogether absent (fig. 1). The shell is marked with hexagonal or pentagonal reticulations which are so faint as to be seen only with great difficulty. The dorsal margin of the shell is quite smooth. The ventral margin is slightly serrated anteriorly, but posteriorly is rendered uneven by minute, blunt teeth, rather irregularly disposed, and is fringed with long setæ. The head is erect and rounded, with a conspicuous ridge over the eye (fig. 22). The large upper lip begins anteriorly with a marked ridge and is ridged transversely as is the case in *M. triserialis*. The eye and ocellus are small. The first pair of antennæ are long and nearly straight, not dilated at their extremity; along the inner edge are three large spines, while at the extremity there are two semi-rings of small spines. The tail is of the usual shape, the part anterior to the anus densely setiferous, the setæ apparently not arranged in any definite plan (fig. 2). The anus is guarded by a pair of peculiar flaps. Posterior to the anus the ventral edge of the tail is armed with a row of very minute teeth.

Length of female, ·8—·95 mm.

Width, ·55— ·65 mm.

Found at Chakradharpur (Nos. 14, 16).

9. *Macrothrix goeldi*, Richard.

A single specimen of a Macrothrix was found in some washings from *Spongilla carteri* taken in the Museum tank, Calcutta.

It agrees in all respects with the description given by Richard except in point of size, my specimen, which has no eggs in its brood-pouch and is perhaps not fully grown, being smaller than the type. The species has only been recorded from Chili (Richard, 1897).

10. *Thyocryptus longiremis*, Sars.

A very decayed young specimen, which I refer doubtfully to this species, occurred in a collection in Calcutta (No. 13).

11. *Camptocercus australis*, Sars.

A single female specimen was contained in one of the collections from Chakradharpur (No. 14).

Distribution.—Sumatra, Australia, South America (Argentine and Patagonia).

12. *Lynceus cambouei* (De Guerne and Richard).

Two specimens only in a collection from Chakradharpur (No. 14).

Distribution.—Madagascar, German East Africa, Palestine, Tonkin, Hawaii, Chili, Patagonia.

13. *Lynceus guttatus* (Sars).

A few specimens from the Calcutta maidan and Zoological Gardens (Nos. 12, 13).

Distribution.—Europe, North and South America, Asia and North Africa.

Not uncommon in Calcutta (Nos. 12, 13).

14. *Leydigia australis*, Sars.

Two specimens of this species were taken at Chakradharpur (No. 16).

Distribution.—Ceylon and Australia (Queensland).

15. *Leydigia acanthocercoides*, Fischer.

With some doubt I refer to this species portions of a moulted skin found in a collection from a tank in the Zoological Gardens at Calcutta (No. 13). The form of the postabdomen is in agreement, but I cannot speak for the rest of the body.

16. *Alonella excisa* (Fischer).

A few specimens only, found at Chakradharpur (Nos. 14, 16).

This species appears to occur in every part of the world except Africa.

17. *Chydorus sphæricus* (O. F. Müller).

A very few specimens of this species were taken at Chakradharpur (Nos. 14, 16, 17).

18. *Chydorus globosus*, Baird.

Two somewhat immature specimens of this species were found in a collection from the Museum tank at Calcutta (No. 8).

19. *Dunhevedia crassa*, King.

A single specimen was found in the Museum tank.

If the identity of this species with *D. setigera* (Birge) is accepted (Stingelin, 1904), then its distribution is practically world-wide.

COPEPODA.

20. *Pseudodiaptomus lobipes*, n. sp.

Body slender and more or less cylindrical, the head fused completely with the first thoracic segment (fig. 3). The last segment of the thorax is rounded at the angles and bears on each side a small spine, but no cilia. The abdomen, in the female, consists of four segments; the genital segment is scarcely at all dilated. Dorsally it bears minute spines arranged in three transverse rows, the two anterior rows broken in the middle (figures 23 and 24). Laterally there are two groups of larger spines, about four in each group. The posterior edges of the two succeeding segments bear each a row of teeth. The last segment is much shorter than the preceding ones. The furcal rami are divergent, and about four times as long as wide, with long cilia fringing the inner edge. In the male the abdomen consists of five segments, the second, third and fourth toothed along their posterior edge.

The antennæ are scarcely as long as the thorax and consist of twenty-one joints. In the male the terminal section of the prehensile antenna consists of three joints, the line of division between the second and third not very distinct.

The fifth foot of the female is one-branched and made up of three joints (fig. 4). The second joint, which is the longest, is produced at its distal external angle into a strong spine. On its inner face, towards the end, it bears two hyaline membranes the distal one very large. The last joint is produced distally into a long strong spine, and at the base of it there are three short ones. Of these three one is stouter than the others and is toothed on each side; the other two are toothed along one side only.

In the male the right foot of the fifth pair is one-branched and consists of six joints in all, apparently a two-jointed basal part and a four-jointed exopodite (fig. 6). The second joint of the exopodite is produced into a strong spine. The terminal joint is broad and flattened at the base, but continued as a curved spine (fig. 7). The left foot (fig. 8) consists of a basal portion bearing a long laminal process corresponding to the endopodite, and a distal part of two joints representing the exopodite. The second joint of the exopodite is broad and flattened, with a small hyaline membrane on its outer edge.

Length of female, ·35 mm.
,, ,, male, ·95 mm.

Numerous females of this species were found in two collections made in Calcutta (Nos. 12, 13), but it was only after prolonged search that I was able to find a single male. This is all the more remarkable inasmuch as most of the females bore long, slender spermatophores.

21. *Diaptomus contortus*, n. sp.

The form of the body in both sexes is slender, tapering considerably in front, and with the greatest breadth somewhat behind the middle (fig. 9). In the female the division between the fourth and fifth segments of the thorax is marked by a ring of fine denticles. In the male the ring is incomplete dorsally. The fifth segment is scarcely at all expanded laterally and is armed on either side with two teeth, those on the left being larger than those on the right. The first segment of the abdomen is very short, scarcely longer than the second, and bears a long and very stout spine on the left and a shorter and smaller one on the right. In the male the first segment bears a long, slender spine on the right side. The antennæ of the female reach, when reflexed, considerably beyond the end of the furcal setæ. In the male the antepenultimate joint of the prehensile antenna is produced into a short process, recurved at the end, less than half the length of the succeeding joint The last joint has no process.

In the last pair of legs of the female the basal joint bears a very large, spine-like, cuticular process, which appears to be generally larger on the right leg than on the left (fig. 10). The endopodite reaches nearly to the end of the first joint of the exopodite, and is pointed at the end, with a ring of cilia, but no setæ. The second joint of the exopodite bears a very large lateral tooth, at the base of which the vestigial third joint may be detected in the form of a minute tubercle bearing two setæ, one long and one short.

In the male the right leg of the fifth pair is conspicuous for the number and arrangement of the .hyaline membranes borne by it. The basal joint bears one pointed process ; the second basal joint bears a large rounded hyaline membrane on its inner face, while the first joint of the exopodite bears two hyaline membranes, one of which has a peculiar semi-lunar outline. The endopodite is slender and cylindrical, longer than the first joint of the exopodite. The second joint of the exopodite bears a large lateral spine rather proximal of the middle. The apical claw is long and much curved, being swollen at the base and peculiarly twisted. In the left leg the terminal joint of the exopodite has a peculiar chela-like shape, owing to the long spine borne by it opposing itself to the very much produced joint itself.

Length of female, 1·25 mm.
,, ,, male, 1·0 mm.

This species occurs in considerable numbers in several collections both from Calcutta and Chakradharpur (Nos. 7 8, 9, 16, 17).

22. *Diaptomus cinctus*, n. sp.

Form of the body slender, of almost equal width throughout, the head marked off from the thorax by a constriction (fig. 11). The line of division between the last two thoracic segments is marked by a ring of minute teeth. In some specimens the ring appears to be incomplete, no denticles being visible on the dorsal surface. In the female the last thoracic segment is asymmetrical; on the right it is simply rounded and bears a single small spine, while on the left it is produced into a peculiar rounded lappet bearing two short spines. In the male this segment is also slightly asymmetrical, being somewhat produced on the right, bearing a spine on this side, but being simply rounded on the left. The abdomen of the female consists of three segments, of which the first is as long as the other two and the furca together. This segment is not much dilated and bears a spine on each side, that on the left being a little posterior to and larger than that on the right. In the male the first abdominal segment bears a long, slender spine on the right side.

The antennæ reach, when reflexed, considerably beyond the furcal setæ. The prehensile antenna of the male is scarcely at all dilated; the antepenultimate joint has a narrow hyaline lamella, and is prolonged into a curved process about two-thirds as long as the succeeding segment and minutely bifid at the tip.

The fifth leg of the female has the endopodite about three quarters the length of the first joint of the exopodite, one-jointed and slender fig. 12). The third joint of the exopodite is absent, its place being taken by two short spines with a seta between them. The second joint seems to be variable in length, in some specimens, and in one case in one leg of the two, it is shorter and stouter than in the one regarded as typical. In the male the basal joint of each leg bears a hyaline lamella on its inner face. The endopodite of the right leg is short and conical, longer than the first joint of the exopodite The endopodite of the left leg is rather long and slender and the exopodite is finger-shaped, with a long inner seta. The second joint of the exopodite of the right leg bears a short lateral spine very near its base. The terminal spine is relatively short and blunt at the tip.

Length of female, 1·15 mm.
,, ,, male, 1·0 mm.

A few females and two males occurred in a swamp at Chakradharpur and one or two specimens in a tank at the same place (Nos. 14, 16).

23. *Diaptomus blanci*, De Guerne and Richard.

Several specimens taken at Chakradharpur (No. 17).

24. *Diaptomus pulcher*, n. sp.

Body rather stout, the greatest width about the middle, tapering anteriorly (fig. 13). The last thoracic segment of the female but little expanded, and slightly asymmetrical in both sexes. In the female the left side is produced rather more than the right, the reverse being the case in the male. In the male each wing of this segment ends in a sharp point. The abdomen of the female consists of three segments, the first being longer than the last two and the furca combined. It is of nearly equal width throughout and bears on either side, a short delicate spine. In the male the abdomen consists of five segments. The first bears a rather long, slender spine on the right side, while the fourth is slightly asymmetrical, being produced somewhat backwards to overlap the succeeding segment on the right, in this respect resembling *D. doriai*, Richard. The furcal rami are not divergent and are ciliated in the female on both sides.

The antennæ extend, when reflexed, somewhat beyond the furcal setæ. In the male the prehensile antenna is not much expanded (fig. 14). The antepenultimate joint has a narrow hyaline lamella and a series of teeth (fig. 15). Of these teeth one is large and directed forward and outward beyond the end of the joint. Behind this tooth there are three or four smaller ones springing from the edge of the joint. In one specimen the two posterior teeth appeared to form part of the hyaline lamella, and not to spring from the joint itself.

In the fifth foot of the female (fig. 16) the basal joint has a large spine on its external face; the endopodite is little more than half as long as the first joint of the exopodite, and its end is fringed with hairs. The third joint of the exopodite is quite distinct and bears two setæ.

The right leg of the fifth pair in the male (fig. 17) has a small hyaline lamella on the second basal joint, and the endopodite is barely as long as the first joint of the exopodite. The second joint of the latter is narrow and curved, bearing a large lateral spine very near its base. The left leg has two small hyaline lamellæ on the second basal joint; the endopodite is relatively long, about two-thirds as long as the exopodite.

Length of female, 1·9—1·95 mm.
,, ,, male, 1·75 mm.

Occurrence.—Swamp at Chakradharpur (No. 14).

25. *Diaptomus doriai*, Richard.

Fairly common at Chakradharpur (Nos. 14, 16).

A species so far only known from the Oriental Region, but widely distributed within that Region.

26. *Diaptomus similis*, Baird.

A few specimens found at Chakradharpur (No. 17).

Distribution.—Palestine and Turkestan.

27. *Diaptomus strigilipes*, n. sp.

Body stout and cylindrical, the last two segments of the thorax completely fused (fig. 18). In the female the last segment of the thorax is expanded into rather large wings, each with two very small, blunt teeth. In the male this segment bears a slender sensory spine on either side. The abdomen of the female consists of three segments, of which the first, or genital, segment is longer than the rest of the abdomen. It is somewhat asymmetrical, bearing a short sensory spine on the left, but being produced on the right (fig. 18*a*) into a finger-shaped process bearing a minute sensory tooth at the apex and one on the dorsal face.

The antennæ are very much longer than the whole body. The prehensile antenna of the male is not much expanded; the antepenultimate joint has no hyaline lamella and is produced into a long, slightly curved process.

In the fifth leg of the female (fig. 19) the basal joint bears a very large tooth on its external face: the endopodite is nearly the same length as the first joint of the exopodite, pointed and ciliated at its extremity. The second joint of the exopodite, or claw, has a conspicuous jagged edge, with a variable number of teeth, and may have, in addition, two little teeth on its external face. The third joint is distinct and bears two slender spines.

In the male the second basal joint of the fifth pair of legs bears a small hyaline lamella (fig. 20). The endopodite of the right leg is very much longer than the first joint of the exopodite and is constricted at the end. The second joint of the exopodite is curved and tapering, with a very large lateral spine. The terminal joint is long and sickle-shaped. In the left leg the endopodite is long and slender and the exopodite terminates in a rounded knob bearing an inner short process.

Length of female, 1·3—1·4 mm.
,, ,, male, 1·25—1·3 mm.

Found at Chakradharpur (No. 14).

28. *Cyclops oithonoides*, Sars.

A few specimens taken at Chakradharpur (No. 14).

Distribution.—Europe, Asia Minor, Central Asia, Malay Archipelago, New Guinea, Egypt, North America.

29. *Cyclops leuckarti*, Claus.

By far the commonest Cyclops in these districts.
Collections Nos. 6, 7, 8, 9, 11, 12, 13, 14, 17.

30. *Cyclops serrulatus*, Fischer.

This species appears in several collections (Nos. 11, 13, 14, 15, 16) but does not seem to be abundant. It is a species of world-wide distribution.

31. *Cyclops fimbriatus*, Fischer

Only found in the Museum tank (No. 10). It seems to occur in every part of the world.

32. *Cyclops prasinus*, Fischer.

Common both in Calcutta and Chakradharpur (Nos. 10, 12, 13, 14).

33. *Cyclops diaphanus*, Fischer.

A few specimens found at Chakradharpur (No. 16).

Distribution.—Europe, Palestine and Central Asia.

34. *Cyclops varicans*, Sars.

Calcutta and Chakradharpur (Nos. 10, 13, 14, 16).

Distribution.—Europe, Palestine, North and South America, Patagonia.

OSTRACODA.

35. *Stenocypris malcolmsoni*, Brady.

Chakradharpur (No. 16).

LIST OF REFERENCES.

Brady, G. S.—" Notes on Entomostraca collected by Mr. Haly in Ceylon," *Journ. Linn. Soc. Zool.*, xix, 1886, p. 293.

Daday, E.—" Mikroskopische Süsswaser-Thier aus Ceylon," *Termes. Füzetek.* Auhangrheft Zum, xxi, Bd. 1898.

Daday, E.—" Unteruchungen über die Copepoden-fauna von Hinter-indien, Sumatra and Java," *Zool. Jahrb. Syst.*, xxiv, heft 3, 1906.

Gurney R.—" On some freshwater Entomostraca in the collection of the Indian Museum, Calcutta," *Journ. and Proc. Asiat. Soc. Bengal*, N. S. ii, No. 7, 1906.

Richard, T.—" Entomostracès de l'Amérique du Sud, recueillis par Mm. Deiters, von Thering, G. W Müller et C. O. Poppe," *Mem. Soc. Zool. de France*, x, 1897, pp. 263—301.

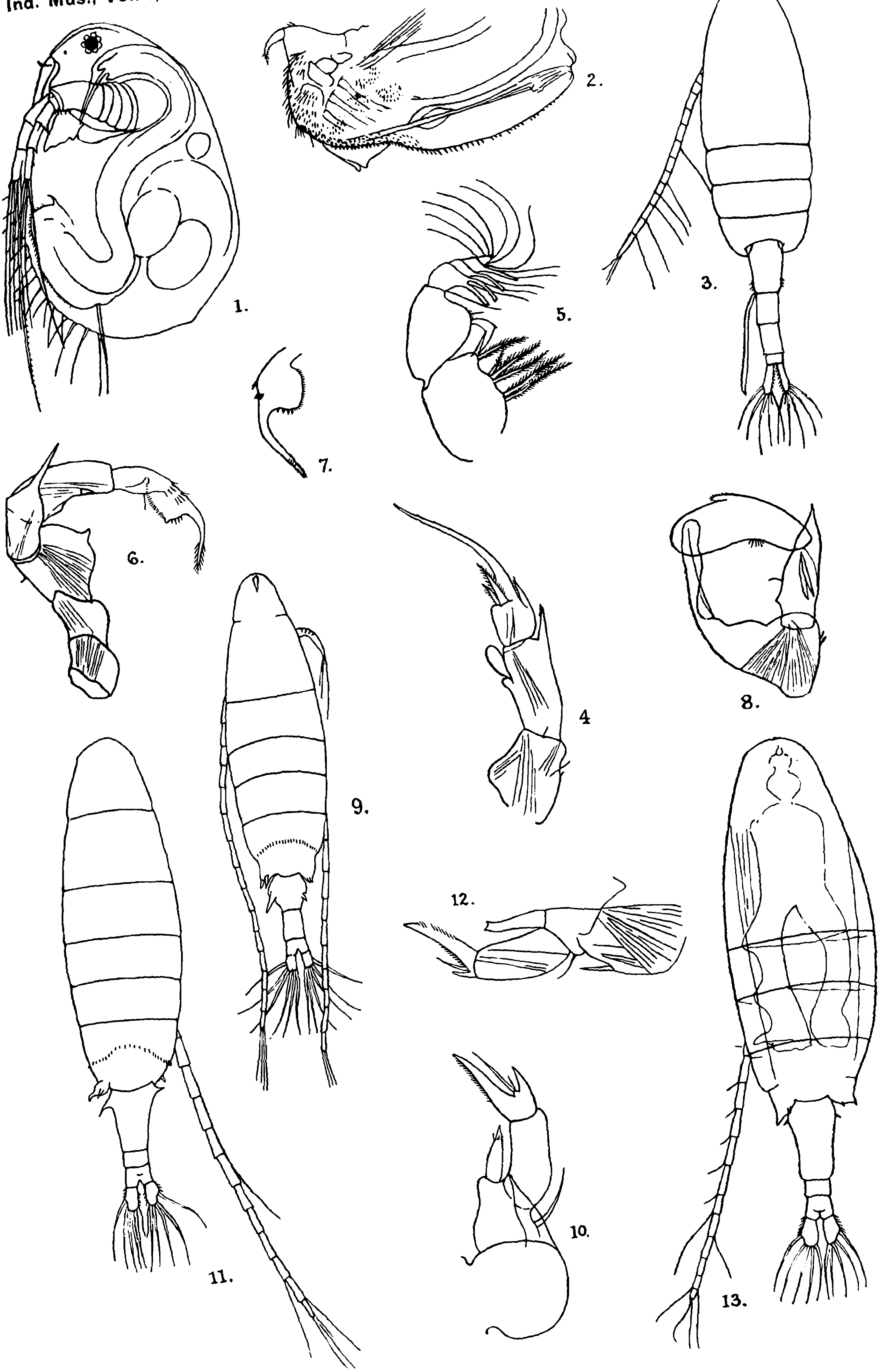
Stingelin, Th.—" Untersuchungen über die Cladoceren—Fauna von Hinterindien, Sumatra and Java," *Zool. Jahrb. Syst.*, xxi, heft 3, 1904.

DESCRIPTION OF PLATES I and II.

Fig. 1.	*Macrothrix tenuicornis*, n. sp.—	Side view of female.	× 482
Fig. 2.	,, ,,	Postabdomen	× 150
Fig. 3.	*Pseudodiaptomus lobipes*, n. sp.—	Dorsal view of female.	× 51
Fig. 4.	,, ,,	Fifth foot of female.	× 260
Fig. 5.	,, ,,	Maxillipede of female.	× 260
Fig. 6	,, ,,	Right fifth foot of male.	× 260
Fig. 7	,, ,,	Terminal joint of same.	
Fig. 8.	,, ,,	Left fifth foot of male.	× 260

Fig. 9. *Diaptomus contortus*, n. sp.—Dorsal view of female. × 26
Fig. 10 ,, ,, Fifth foot of female. × 260
Fig. 11. *Diaptomus cinctus*, n. sp —Dorsal view of female. × 70
Fig. 12. ,, ,, Fifth foot of female. × 260
Fig. 13. *Diaptomus pulcher*, n. sp.—Dorsal view of female. × 48
Fig. 14. ,, ,, Prehensile antenna of male × 100
Fig. 15. ,, ,, Terminal joints of the same. × 440
Fig. 16. ,, ,, Fifth foot of female. × 260
Fig. 17. ,, ,, Fifth feet of male. × 150
Fig. 18. ,, *strigilipes*, n. sp.—Dorsal view of female. × 64
Fig. 18*a*. ,, ,, Right-hand process of genital segment.
Fig. 19. ,, ,, Fifth leg of female. × 260
Fig. 20. ,, ,, Fifth feet of male. × 150
Fig. 21. *Macrothix triserialis*, Brady.—Head. × 150
Fig. 21*a*. ,, ,, ,, Margin of shell. × 260
Fig. 22. ,, *tenuicornis*, n. sp.—Head. × 150
Figs. 23, 24. *Pseudodiaptomus lobipes*, sp. n.—Genital segment highly magnified.

Rec. Ind. Mus., Vol. I, 1907.



THE FAUNA OF BRACKISH PONDS AT PORT CANNING, LOWER BENGAL.

PART I.—INTRODUCTION AND PRELIMINARY ACCOUNT OF THE FAUNA.

By N. ANNANDALE, *D.Sc., Officiating Superintendent, Indian Museum.*

INTRODUCTION.

The settlement of Port Canning is situated on the Matla rivei, one of the numerous creeks which run up into the delta of the Ganges, about sixty miles from the open sea. Partly at any rate in connection with the Port Canning Improvement Scheme,[1] which was believed some forty years ago to be about to transform the place into a port rivalling that of Calcutta, a high embankment has been built up along the bank of the estuary, protecting the low-lying land in the neighbourhood from all but exceptional floods. The earth out of which this embankment was formed was apparently dug from a series of pits situated at a short distance, varying up to about a quarter of a mile, from the present edge. These pits are further supplemented by a number of smaller ones immediately behind the embankment, which is repaired with earth dug from the latter when it is injured by an unusually high flood. The original pits vary in size, but all have an area of something approaching half an acre. They are now filled with water and are the ponds dealt with in this paper. Judging from maps in the office of the Port Commissioners, Calcutta, they did not exist in 1855. It is evident from Stoliczka's account,[2] however, that at any rate some of them existed thirty-nine years ago, and he does not say that they had then been dug recently.

The account referred to deals in particular with an Actinian and a Polyzoon taken in the ponds ; but it is by no means clear in which pond Stoliczka found his *Sagartia schilleriana*, as there are several ponds "close to the railway station." This point is of importance, because he was only able to find the Actinian in one pond, the position of which he describes in the manner indicated. One factor in the environment of forty years ago, however, has certainly changed ; for he gives as one reason why the Actinian was not to be found in the other ponds that the one close to the station alone

[1] See Hunter, *A Statistical Account of Bengal,* vol. i, pp. 91—98 (London, 1875).
[2] In *Journ. Asiat. Soc. Bengal,* part ii, 1869. p. 52.

contained logs of wood to which the animal could attach itself, and now these logs are no longer to be found, either in the pond which is nearest to the railway station or in any other in the neighbourhood; they have evidently been removed by human agency or else have rotted away. The bottom of all the ponds now consists of soft mud, which is devoid of any hard substances except an occasional twig, small tree-stump, or brick, and as there are very few trees in the vicinity, twigs are rare and tree-stumps still more so. The bricks are also scarce, being derived from ruined drains and wells, and there are no stones in this part of Bengal. The ponds are all shallow (probably at no point more than ten feet deep when full) but the depth of the mud at their bottom is considerable. It is black beneath the surface, contains a large amount of organic matter and smells foul when disturbed.

The flora of the ponds consists chiefly of filamentous and unicellular algæ; but in some cases two or three species of Phanerogams occur, notably at least two of *Naias*, a duckweed and a true water-lily, the last being rare, the first abundant in some of the ponds.

An important factor in the environment is the nature of the water. I have described the ponds as brackish, but at some time of the year the water may contain the same proportion of soluble salts as the sea, at others it may even be more strongly saline, and again at others it is much more nearly fresh. As a rule the ponds are completely isolated both from one another and from the estuary. During the cold weather they are exposed to evaporation, which becomes intensified during the hot weather. During the rainy season, on the other hand, they become filled up with fresh water and probably often coalesce. They are also liable to be placed in temporary communication with the estuary occasionally, owing to a flood bursting the embankment; but this does not occur by any means every year. When it does happen, it happens owing to the estuary being swollen with fresh water, which is flowing down from up-country; so that the ponds, even under these conditions, are practieally cut off from the sea.

Stoliczka, apparently in 1868 or 1869, had the water of the ponds analysed; but he does not say at what time of year his samples were obtained. He found that the proportion of soluble solids was 12·87 per thousand, sea-water containing from 32 to 39 per thousand. Mr. D. Hooper, Curator of the Industrial Section of the Indian Museum, has kindly examined samples taken by myself in December and March last. Two samples came from a pond in which the Hydrozoon *Irene ceylonensis*, as well as the Actinian, was reproducing its species, and in which the plant *Naias* was abundant. A sample taken from this pond at the beginning of December, a few weeks after the end of the rainy season, was found to contain 12·13 per thousand of soluble salts, while another taken on March 17th contained 20·22 per thousand. At the latter date water from the edge of the Matla at Port Canning contained 25·46 per thousand, and that from a second pond near the first

23·16. This second pond had a fauna almost identical with that of the first except in the absence of the Hydrozoon; but its flora was entirely cryptogamic.

I am indebted to Capt. J A. Black, I.M.S., Chemical Examiner to the Government of India, for a more detailed analysis of a sample from the second pond taken on January 6th. It is as follows:—

Chloride of Sodium	13·8 parts per thousand.
,, ,, Magnesium	0·6 ,, ,, ,,
Sulphate of Magnesium	0·7 ,, ,, ,,
,, ,, Calcium	2·1 ,, ,, ,,
Nitrates, etc.	0·3 ,, ,, ,,
Total .	17·5

Stoliczka's analysis was, in detail, as follows:—

"Chloride of Sodium (including Potassium)	9·81
,, ,, Calcium	0·46
,, ,, Magnesium	0·93
Sulphate of Magnesium	1·17
Carbonic acid, etc.	0·50";

the soluble substances being also calculated in parts per 1,000.

Stoliczka noted that the water in the ponds was almost fresh during the rains, and in the tank from which my first sample was taken the water-level had sunk only a short distance below the top of the bank, the dry weather having been of no more than a few weeks' duration. All that can be said, therefore, as regards the salinity of the water in the ponds, is that it varies considerably at different times of the year. The range in variation which the members of the fauna are able to survive, is perhaps more remarkable than what may be regarded in different instances either as the deficiency or the excess of salt in the medium in which they live.

THE FAUNA OF THE PONDS.

I do not propose at present to attempt more than a general description of the fauna of these ponds, with notes on some particularly striking species. Specimens of several important groups are now in the hands of specialists in Europe, whose determinations will make a more detailed discussion of greater value after their researches are complete.

Protozoa.—The most conspicuous representatives of the Protozoa found in the ponds are *Carchesium polypinum* and *Folliculina ampulla*. The latter of these is commonly found in salt water but also occurs in fresh, while the *Carchesium* is commonly an inhabitant of fresh water. In the ponds, *F. ampulla* occurs most frequently in close association with the Hydroid stage of *Irene ceylonensis*. Indeed, so frequently is this the case that I was able in almost all instances to detect the presence of the Hydroid, itself almost invisible to the naked eye, by the dark spots due to groups of the Protozoon among the branches of its hydrorhiza. The Protozoon also occurs independently in the ponds, but rarely. *Carchesium polypinum* is just as frequently found attached to colonies of the Polyzoon *Victorella pavida*, but is also common apart from this animal.

Many other representatives of the Protozoa were taken in the ponds; they have been submitted, together with other microscopic organisms, to Prof. von Daday, of Buda-Pesth.

Porifera.—It was in the same ponds that my types of *Spongilla lacustris* var. *bengalensis* (1) were taken in the winter of 1905–6, but in that of 1906–7 this form was entirely replaced by another agreeing closely with Bowerbank's description of his *S. cerebellata* (2). Other specimens, taken near Calcutta and in northern Bengal and sent me from the Chilka Lake in Orissa, convince me that the two forms are identical as regards taxonomic position, being no more than temporary phases of *S. alba*, Carter (3), which in its turn may be no more than an Oriental race of the widely distributed *S. lacustris*. This is a point, however, which I hope to discuss more fully on another occasion. All the sponges in the ponds had perished and most had completely disintegrated by the middle of March.

A notable point as regards these Sponges growing in brackish ponds is the number of animals which take temporary or permanent shelter in their canals. Not only do several species of Amphipods common in the ponds use these canals as temporary resting-places, but an Isopod of distinctly marine facies is common in them and is apparently not found elsewhere in the same habitat. Several small Lamellibranch Molluscs (*Corbula*, spp.), young individuals of the Actinian to be described later, a larval Dragon Fly, and several species of Chironomid larvæ were also found in the canals of the Sponge, while a Cirripede (*B. amphitrite*) was taken buried in the substance of one specimen. In my account of *S. lacustris* var. *bengalensis*, I noticed that those specimens of the Sponge which had any definite colour were dark green owing to the presence in them of a filamentous alga. A similar case of apparent symbiosis has been recorded from Celebes by Professor and Mme. Weber (4); but I am now confident that in such cases the alga should be regarded as a parasite of the Sponge. In keeping certain species of freshwater Sponge, *e.g.*, *S. carteri*, alive in an aquarium in Calcutta, one of the difficulties to be contended with is the rapid growth of just such filamentous algæ, which block up the canals and finally kill the organism. In the Port Canning ponds Sponges infested with the alga are evidently in an unhealthy condition and are usually found towards the end of the season.

Cœlenterates.—Besides the form of *Metridium schillerianum* (Stol.) to be described in a subsequent paper of this series, I have only found one Cœlenterate in the ponds, namely the Hydrozoon *Irene ceylonensis* (5); and that only in one pond. The Medusæ were abundant from the end of November till the beginning of January.

At the beginning of December they were not sexually mature; at Christmas G. C. Chatterjee found specimens in which he could detect ova; at the beginning of January only spent individuals, dead or moribund, could be procured, their umbrellas persisting for some days after the sense-organs and gonads had disappeared. At the last date, however, specimens of the Hydroid were taken in which the gonophores still bore gonosomes half developed. A second brood was sexually mature in March. I have already described the Hydrozoon of this species briefly, and hope to do so more fully in the present series; the Medusa was described by Browne from the seas of Ceylon. Both Medusa and Hydroid show a power of resisting unfavourable conditions (especially lack of aëration of the water) remarkable in their order and contrasting markedly with the feeble nature of this power displayed by *Hydra* in India. A large number of the Medusæ lived for over 48 hours in a small corked tube of water in which a single *Hydra* would hardly have survived for an hour.

In the smaller ponds near the embankment I found two other Hydrozoa, one of which appears to be specifically identical with the European *Bimeria vestita*, which has recently been recorded from South America (6), while the other represents a new species of *Syncoryne*. None of these genera have representatives in fresh water, but all belong to the littoral zone.

Mollusca.—Stoliczka (7) stated that most of the Mollusca in the ponds belonged to marine types; but this is putting the matter a little too strongly, for many of the species belong to characteristic lacustrine genera, while others are common in estuaries. Nevill (8) describes *Hydrobia* (*Belgrandia*) *miliacea* as occurring in " brackish-water ponds (at Port Canning), associated with *Valvata* (?) *microscopica*, Nev., new species of *Blythinia*, *Martesia*, *Teredo* (?), *Pharella*, *Theora*, *Stenothyra blanfordiana*, etc." Preston (9) has recently described five new species of *Corbula* and one of *Bithinella* from my own collection, and I have also found an *Ampullaria* and two species of *Melania*. Although several species of *Onchidium* are not uncommon on the banks of the Matla, while at least one occurs in ditches and pools of brackish water as far inland as Calcutta, I have not found any in the Port Canning ponds.

Nematode.—Dr. von Linstow (10) has described a new Nematode of the genus *Oncholaimus* from the ponds. All previously known species of this genus are marine.

Rotifers and Gastrotricha.—The Rotifers have been submitted to Prof. von Daday. In January, 1906, I took among filamentous algæ from the ponds a representative of the Gastrotricha which agrees very closely with Zelinka's (11) figure and description of *Chætonotus schulizei*, which I have also seen in a similar situation in freshwater tanks in Calcutta and Chota Nagpur.

Annelid.—The only Annelid seen was a small Polychæte which burrows in the mud in great numbers.

Polyzoa.—Stoliczka (7) took the Cheilostome *Membranipora bengalensis* in the Port Canning ponds thirty-eight years ago, but notwithstanding a very diligent search, I have been unable to find it in them now, although it still occurs in the estuary at the same place. The only common form in the ponds at present is a Ctenostome which I take to be specifically identical with the European *Victorella pavida*. The Indian form, however, grows more luxuriantly than the European, and often covers large areas on grass-roots and the like; the zoœcia often arise very close together on the stolon and comparatively seldom produce buds. All the individuals I have seen expanded have had eight tentacles. *Victorella* is essentially a brackish-water form, and even *Membranipora* occurs elsewhere in marshes the water of which contains considerably less salt than that of the sea. Miss L. Thornely has lately identified a species found incrusting a brick in one of the ponds as *Bowerbankia caudata* (Hincks); this species also belongs to a genus common in estuaries.

Crustacea.—Of the higher Crustacea all that I can say at present is that the crabs, which are common among the Sponges in the ponds, belong to the genus *Varuna*, which is generally found in the neighbourhood of estuaries, whence it is liable to be carried out to sea (Alcock, *A Naturalist in Indian Seas*, p. 75). Dr. J. de Man has kindly promised to examine specimens of the Decapods, while the Rev. T. R. R. Stebbing has already reported a new genus of Gammarids (which will be described in a future number of these "Records") among the Amphipods.

Gurney (12) has identified the Daphniid *Ceriodaphnia rigaudi* and Copepod *Cyclops leuckartii*, both freshwater species, among the Entomostraca. To these I can add two species of the marine order Cirripedia. A single specimen of *Balanus* was found deeply buried in the tissues of a *Spongilla* and attached to the grass-root to which the Sponge had also affixed itself, in December, 1906. The specimen was small and distorted, probably owing to the nature of its support, but it could be readily identified with *Balanus amphitrite*, a species common at the mouth of the Ganges and having an extraordinarily wide bathymetric range in the Indian seas, for Gruvel (13) has recently recorded examples of the variety *communis*, with which the Port Canning specimen should perhaps be identified, from a depth of over 1,000 fathoms. In another of the ponds I found a brick to which several specimens of *B. patellaris* were attached. This species is abundant in the Matla, occurring with *B. amphitrite* and *Chthamalus stellatus*.

Insects—G. C. Chatterjee (14) found the larva of the Mosquito *Anopheles rossi* abundant in the ponds at the beginning of December and less so towards the end of the same month. Though somewhat scarce, relatively speaking, they were still to be found at the beginning of January; in March I could only find one individual. At all periods between December and the end of March I took several Dragon Fly [1] larvæ, of which *Ischneura senegalensis*

[1] For observations on Dragon Fly larvæ in brackish water in America see Osburn in the *American Naturalist*, vol. xl, p. 395 (1906).

a common species throughout India, was the most abundant. I also took larvæ of an Ephemerid and of at least two Chironomid flies in December and January; they sheltered themselves indifferently in the canals of Sponges or among the zoœcia of Polyzoa. During the winter months, at any rate, adult insects of a large number of species are abundant in the ponds. Among the Hemipterous genera represented the following may be mentioned: (surface forms) *Gerris*, *Hydrometra*, *Microvelia* and *Mesovelia*; (forms which live below the surface) *Laccotrephes*, *Nectocoris Anisops*; the only common genus not so well represented in the ponds as in the freshwater tanks of Calcutta being *Plea*, with the possible addition of *Sphærodema*. Both these genera, however, very frequently rest among the hanging roots of *Pistia stratiotes* (the Water Plantain), which does not occur in the ponds at Port Canning. Most of the aquatic Coleoptera collected were minute forms, and no Gyrinidæ were seen; but a few common species of large size (*e.g.*, *Cybister convexus*) were taken. Several small Tettigids (Orthoptera) were observed swimming on the surface of the ponds—a habit shared by a large number of the members of this family; and in March a Lepidopterous larva (apparently a species of *Nymphula*) is common on *Naias*, making a cylindrical case like that of a Caddis-worm.

Fish.—Specimens of the following Fish were taken in the ponds:—

Symbranchus bengalensis (one young specimen).
Amblypharyngodon microlepis.
Macrones gulio.
Barbus chola.
,, *stigma*.
Nuria danrica.
Haplochilus melanostigma.
,, *panchax*.
Gobius acutipennis.
,, *giuris*.
,, *alcockii*.
Apocryptes lanceolatus.
Ophiocephalus punctatus.
Anabas scandens.
Trichogaster fasciatus.

There are also one or two minute Gobies, which, if they are adult, represent new species. Mr. Hodgart, who collected for the Museum at Port Canning, further reports *Periophthalmus kœlreuteri* and *Boleophthalmus viridis* from the ponds; but although these species are common on the shore of the estuary, I have not seen them in any of the ponds. None of these fish can be called essentially marine; but most of them are commonly found in brackish water in the neighbourhood of estuaries. *Barbus chola* is usually found in fresh water, and so is *Haplochilus panchax*, which in the ponds is less abundant than *H. melanostigma*; I have recently taken *Gobius alcockii* in a tank at Rajshahi, 150 miles north of Calcutta. Some of the species (*e.g.*, *O. punctatus*) extend inland even as far as mountain tarns in the Himalayas.

Reptiles and Amphibia.—The only Reptile taken in the ponds was the common Water-snake *Tropidonotus piscator*, and the only Amphibians the equally common *Rana cyanophlyctis* and *R. tigrina*. The Indian Toad, *Bufo melanostictus*, is abundant at the edge of the ponds, in which it possibly breeds; Gardiner (15) has recently recorded this species as inhabiting brackish pools in the Maldives. The range in altitude of these Amphibians, and especially of *R. cyanophlyctis* and *B. melanostictus*, shows that they are very adaptable species.

LITERATURE.

1. Annandale, N. "Notes on the Freshwater Fauna of India, No. I" (*Spongilla lacustris* var. *bengalensis*), *Journ. Asiat. Soc. Beng.* (New Ser.), vol. ii, 1906, p. 55.

2. Bowerbank, J S "Monograph of the *Spongillidæ*," *Proc. Zool. Soc.*, 1863, p. 440.

Carter H. J History, etc., of known species of *Spongilla*," *Ann. Mag. Nat. Hist.* (5), vii, p. 77 (1881).

4. Weber, M. M. and A. "Quelques nouveaux cas de Symbiose," *Ergeb. Nied. Ost-Ind.* vol. i, p. 48 (1890).

5. Annandale, N. "Notes on the Freshwater Fauna of India, No. XI" (the Hydroid of *Irene ceylonensis*), *Journ. Asiat. Soc. Beng.* (New Ser.), vol. iii, 1907, p. 79.

6. Hartlaub, C. "Die Hydroiden der magalhaenischen Region," etc., *Zool. Jahrb*, suppl. vi, p. 534 (1905).

7. Stoliczka, F. 'Anatomy of *Sagartia schilleriana* and *Membranipora Bengalensis*," *Journ. Asiat. Soc. Bengal*, part 2, vol. xxxviii, p. 28 (1869).

8. Nevill, G. "New species of Brackish-water Mollusks," *Journ. Asiat. Soc. Bengal*, part 2, xlix, p. 159 (1880).

9. Preston, H. B. "Diagnoses of new Species of *Corbula*," etc., *Ann. Mag. Nat. Hist.* (7), xix, p. 215 (1907).

10. Linstow, O. von "A new Nematode of the genus *Oncholaimus*," *Rec. Ind. Mus.*, i, p. 45 (1907).

11. Zelinka, C. 'Die Gastrotrichen," *Zeitschr. f. Wiss. Zool.*, xlix, p. 209, 1890.

12. Gurney R. "Some Indian Freshwater Entomostraca," *Journ. Asiat. Soc. Bengal*, 1906, p. 273.

13. Gruvel, A. "Cirrhipèdes Operculés," etc., *Mem. Asiat. Soc. Bengal*, ii, p. 1 (1907).

14. Chatterjee, G. C. "Anopheles larvæ," *Rec. Ind. Mus.*, i, p. 82 (1907).

15. Gardiner, J S. *The Fauna and Geography of the Maldive and Laccadive Archipelagoes*, vol. ii, suppl. ii, p. 1049.

THE FAUNA OF BRACKISH PONDS AT PORT CANNING, LOWER BENGAL.

PART II.—A NEW NEMATODE OF THE GENUS *Oncholaimus*.

By DR. O. VON LINSTOW, *Göttingen.*

The Nematode here described was found among filamentous algæ in a pool of brackish water at Port Canning, which is situated on the Matla estuary in Lower Bengal.

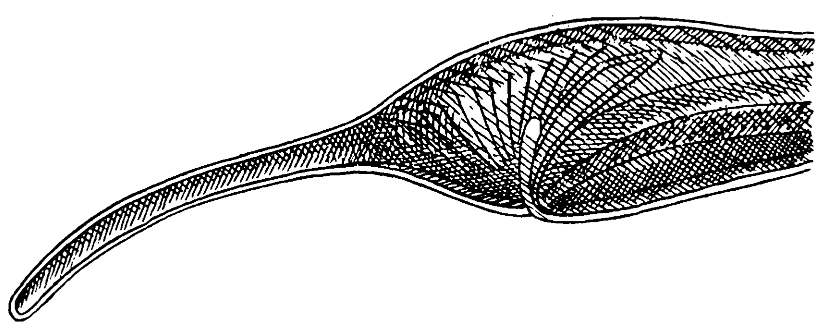


FIG. 1.—Posterior extremity of the male, from the right.

Oncholaimus indicus, sp. nov.

Cuticle smooth, without annular rings. At the anterior extremity there is a large oral cavity measuring 0·036 mm. in length and 0·014 mm. in transverse diameter; in front of this on the ventral surface there is a conical tooth. The caudal end is thickened and narrows abruptly a short distance behind the anus into a caudal appendage, which measures 0·075 mm. in length and 0·0078 mm. in breadth, and is curved inwards slightly towards the belly and rounded posteriorly. This form of tail is identical in the two sexes. Both in the male and in the female the œsophagus measures one-sixth of the total length of the body.

The male is 2·71 mm. long and 0·053 mm. broad, the caudal end occupying 1/25·6 of the length of the whole animal. The spicula are equal, being strongly curved; they measure 0·034 mm. in length. Dorsal to them lies a very short supporting structure.

The female is 2·71 mm. long and 0·057 mm. broad, and in this sex the caudal end measures one twenty-eighth of the total length. The vulva is situated somewhat posterior to the middle of the body and divides the length anterior to it and that posterior in the proportion of 31 to 29. One branch of the uterus stretches forwards, the other backwards. Two eggs are produced, each measuring 0·78 mm. in length and 0·047 mm. in transverse diameter.

The thirty-three known species of *Oncholaimus* live in the sea.

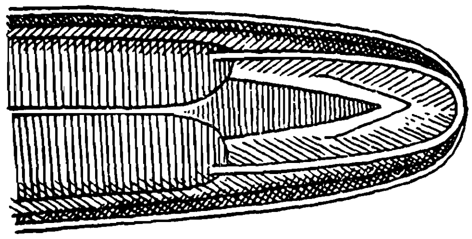


FIG. 2.—Anterior extremity, dorsal view.

[*Oncholaimus indicus* was found in large numbers in the habitat indicated during December, January and March. In the first of these months the water of the pool in which it occurred contained 1·23 per cent. of soluble solids; in January the salinity had increased considerably owing to evaporation; while in March the percentage of soluble solids was 2·022.—N. ANNANDALE.]

THE FAUNA OF BRACKISH PONDS AT PORT CANNING, LOWER BENGAL.

PART III.—AN ISOLATED RACE OF THE ACTINIAN *Metridium schillerianum* (STOLICZKA).

By N. ANNANDALE, *D.Sc., Officiating Superintendent, Indian Museum.*

METRIDIUM SCHILLERIANUM (Stoliczka).

Sagartia schilleriana, Stoliczka, *Journ. Asiat. Soc. Bengal*, part 2, vol. xxxviii, 1869, p 28; plates x, xi; R. Hertwig, *Zool. Rep. H.M.S "Challenger,"* vol. vi, 1882, Actiniaria, p. 71.

Although Stoliczka's description of the typical form of the species is very detailed, the imperfect knowledge of the structure of the Actinians possessed thirty-nine years ago by students of the Cœlenterates, misled him as regards certain important characters, while the fact that he cut no sections prevented him from detecting others. His types are now in a bad state of preservation, the tissues being shrunk and partly decomposed, and have assumed a dark brown colour of which I have been unable to get rid. I have, however, cut sections of two of these specimens, which proved to be so far intact that the arrangement of the mesenteries could be detected. Further, I have made vertical and transverse sections of two fresh examples of this form, and have dissected two others, as well as sectioning four specimens of the new variety, dissecting six, and examining a very much larger number externally. The following description of the species and its variety is based on the material thus used. Although it differs considerably from Stoliczka's written description, it will be found to be in most respects, so far as the typical form is concerned, in accord with his figures, which, for the reasons given above, he appears to have misinterpreted in spite of the accuracy of his observations.

DESCRIPTION OF THE TYPICAL FORM OF THE SPECIES.

Colourless in spirit; in life translucent, the column being more or less deeply tinged with green and having a variable number of semi-opaque vertical stripes arranged in multiples of six and representing the better developed of the intramesenterial spaces; parts of the mesenteries often of a deep purple, which may be visible externally; tentacles semi-opaque, often with irregular transverse bars of opaque white. Column cylindrical, as broad or almost as broad as high when normally expanded, broader than high when contracted; in the latter condition mound-shaped, with a considerable oval aperture as a rule remaining open above the tentacles. Tentacles elongated, tapering, perforate at the distal extremity, arranged in five cycles; the innermost cycle with six tentacles, the next with twelve the third with twenty-four, the fourth with forty-eight, the fifth with ninety-six: 186 in all (approximately). Disk ample, oval, not separated from the column when expanded; the mouth large, elongated and narrow; the lips protuberant, with six folds on either side of the mouth; the stomodæum extending more than half way down the column; the gonadial grooves distinct. External surface of the column smooth, generally with rows of suckets arranged vertically; the cinclides, which are difficult to detect in preserved specimens, scattered. Basal disk variable in outline, often extending beyond the periphery of the column, provided with a distinct sphincter, which is visible in living specimens as a thin, semi-opaque ring Circular muscles of the column well developed, confined to the mesoderm; the sphincter elongate in vertical section, consisting of comparatively feeble folds without muscle spaces; radial muscles of the disk and tentacles situated at the base of the ectoderm and not encroaching on the mesoderm. The six primary (complete) pairs of mesenteries fertile; sometimes the first and rarely also the second secondary cycles fertile; the number of secondary cycles from three to five, each consisting of twelve mesenteries; some mesenteries in one or more of the cycles rudimentary, without fully developed retractor muscles and devoid of filaments; acontia very long. Gonads protogynous, the two elements being produced at different times and in different parts of the mesenteries, the ovaries above the testes.

DESCRIPTION OF AN ISOLATED RACE (var. *exul*) OF THE SPECIES.

Column several times as long as broad, vermiform when extended in young specimens sausage or barrel-shaped when contracted. The walls of the column very thin, allowing forty-eight mesenteries to be visible externally as narrow, semi-opaque vertical stripes. Tentacles as in the typical form, except that there are never more than four cycles; the disk in old specimens much reduced, divided into twelve distinct parts. The stomodæum extending less than half way down the column. Basal disk devoid of a sphincter, its periphery merging gradually into the column. The folds of the subtentacular sphincter markedly deeper above than below, with a few oval muscle spaces above. The six pairs of primary mesenteries alone fully developed, the others as a rule lacking retractor muscles and filaments, but the first cycle, or some of its members, sometimes being fertile though feebly muscular. Cinclides in vertical rows on the upper part of the column.

In all other respects, so far as its taxonomic features are concerned, the characters of the variety may be regarded as identical with those of the typical form.

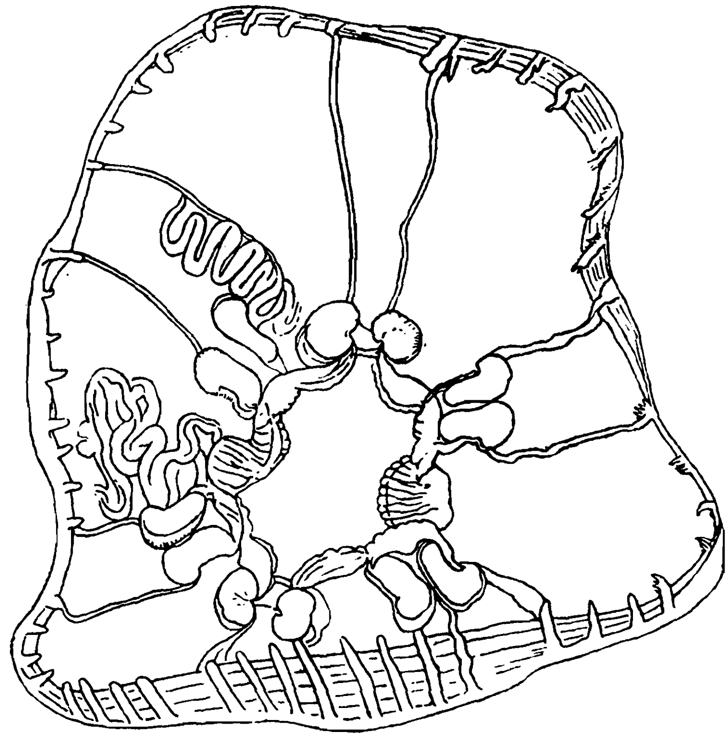


FIG. 1.—Thick transverse section of the column of *M. schillerianum* var. *exul* in the region of the stomodæum, showing the arrangement of the mesenteries, the form of the retractor muscles and the muscular strands of the wall.

COMPARISON BETWEEN THE STRUCTURE OF THE TYPICAL FORM AND THAT OF THE VARIETY.

The above is a general account of the physical characters in which the two forms agree with and differ from one another. In order to explain the manner in which it is probable that these differences have come about, it will be necessary first to compare the structure of the two forms in further detail, and then to give an account of their respective modes of life.

Column.—

The main differences between the typical form and variety are plainly connected with the differences in the form of the column. In the new variety of the species this part of the organism is a thin-walled muscular sac with a bulky lumen; in the typical form the walls are thicker and the cœlenteron very much less spacious. The thinness of the walls in the variety is due to two causes, *viz.*, the nature of the ectodermal layer and the comparatively poor development of the mesoderm. In both forms the ectodermal layer consists of the usual elements, namely, epithelial and glandular cells, sense cells, and nematocysts. The cells do not differ in any feature of importance as regards form or structure from those found in the same layer in other Actinians. Stoliczka has already described and figured the nematocysts (*op. cit.*, plate xi). The secretion of the gland cells mixed with the threads of the nematocysts forms a covering for the column, which, however, is only temporary, and has not the characters of the so-called cuticle found in some Actinians. Unless specimens are very carefully preserved, the whole of the nematocysts of the column and tentacles are forced out of the ectoderm without rupturing, and appear in transverse section to form a separate layer, bound together by slime secreted by the gland cells but external to and distinct from the ectoderm. If living specimens are examined, it will be found that there is no such layer under natural conditions, but that the nematocysts are interspersed with the epithelial and glandular cells. The temporary protective covering is not formed of the nematocysts, but only of their threads and of slime, often with foreign bodies enclosed. In the isolated race the ectoderm consists of a layer of cells parallel to the mesoderm. In the typical form, however, this layer is thrown, all round the periphery of the column, into a series of transverse folds, the function of which I will discuss later. The number of nematocysts and also of gland cells present in this region is perhaps greater in the typical form than in the variety. The suckers, which are as a rule absent in young individuals, consist, in both forms, of relatively deep folds of the ectoderm separated by a space from the mesoderm; they are oval in outline, their main axis being at right angles to that of the column. It is very difficult to detect the cinclides in preserved material, but in life they are easily distinguished as transversely elongated slits with tumid lips. In structure they closely resemble the suckers except that they are perforate; the mesoglœa beneath them is much vacuolated. The vertical rows of suckers, at any rate in the variety, usually correspond to the inter-, those of the cinclides to the intramesenterial spaces; but I have been unable to convince myself that this arrangement is absolutely constant. In the typical form of the species cinclides and suckers occur on all parts of the column, the former being particularly numerous near the two disks; but in the new race both structures are confined to the upper half of the column below the region of the sphincter.

The thickness of the mesoderm is not more than moderate in the typical form; in the variety it is rather less, but the mesoglœa swells out somewhat irregularly in many of the inter- and intramesenterial spaces in such a way that the whole of the layer in such spaces has a roughly spindle-shaped outline in transverse section. In both forms the nerve cells situated towards the external limits of the mesoderm are large and numerous, and in both the mesoglœa itself has a distinctly reticulo-fibrillar structure and contains, especially externally, a number of irregularly placed vertical spaces and channels. In the typical form of the species, the wider folds of the ectoderm rest on slight projections and concavities in the mesoderm, while in both forms broad mesodermal ' bays " occur on the endodermal surface.

The endoderm of the column in both forms consists of considerably elongated epithelial cells provided with cilia, which are particularly long and active towards the upper limits of the column. In the typical form, the number of gland cells interspersed in the epithelium is perhaps greater than in the variety. In the former, the cells lining the intermesenterial spaces are markedly longer, and contain more zooxanthellæ, than those lining the intramesenterial spaces. This difference is not so clear in the variety but appears to exist to a slight extent. In both forms the zooxanthellæ do not encroach upon the basal part of the cells.

An important point to be noted is that the differences in structure of the column are much more marked in the case of full-grown individuals of the two forms than they are in that of very young individuals of the variety and adults of the typical form. As can be seen from the figures on plate iv, young individuals of the variety measuring about 10 mm. in length when contracted, are only about four times as long as broad, their proportions being, however somewhat variable. In full-grown specimens of the same form, however, the length is at least ten times the transverse diameter. When strongly contracted the column of the young individuals assumes a barrel-shaped outline which does not differ very greatly from the conical outline of the typical form in same state, and the younger the individual is, so far as my experience goes, the less is the length in excess of the transverse diameter. It is only well-grown individuals, of over 4 cm. in length when they are contracted, which can be called wormlike, and as will be shown later, contraction takes a different course in full-grown examples of the variety than that which occurs in young examples of the variety or full-grown individuals of the original form. In the typical form and in the young of the variety, the column is able to stand vertically upright, but in larger individuals of the variety this is impossible without artificial support.

Muscles.—

The circular muscular layer of the mesoderm of the column lies within the nervous layer of the same structure and, in the variety, occupies the greater part of the mesoglœa. In the typical form it is relatively less extensive. In the typical form, moreover, the muscle fibres appear to form a continuous sheet, but I am not quite confident as regards this point. In the variety, however, it is easy to see in living and even in well-preserved specimens that this muscle consists of a large number of parallel strands lying closely adjacent to one another in a vertical series. I am not referring to the sphincter, which is formed by a folding of the muscle accompanied by a parallel folding of the whole mesoderm, but to the circular muscle of the column below the sphincter.

In the typical form of the species the sphincter is not visible externally and its folds are so shallow and commence so gradually below, that it is difficult to say at what point it begins to become differentiated. This is also the case as regards young specimens of the variety less than five millimetres long; but even in these it is more powerfully developed. In full-grown specimens of the variety, however, the sphincter region can be distinctly recognized externally, forming a somewhat corrugated and rather opaque band beneath the disk, and measuring about one-twelfth of the whole column in length. It is well shown in fig. 5, pl. iii.

The basal sphincter is formed by a few comparatively deep folds in the circular muscle at the base of the column round the periphery of the basal disk. I can find no trace of it in the variety.

Longitudinal muscle fibres can occasionally be detected in the mesoderm of the column in the typical form ; in the variety they are fairly abundant in the spindle-shaped swellings of the mesoderm referred to in a preceding paragraph.

In both forms of the species, the basilar muscles of the mesenteries are well developed, surrounding outgrowths of the mesoderm at the base of these organs and having a dendritic outline in transverse section. As a rule they are developed almost equally on the two sides of the mesentery ; but their exact outline varies greatly even in different mesenteries of the same individual. The basilo-retractor muscles are on the other hand somewhat feebly developed, accompanying a relatively slight folding of the mesoderm often almost indistinguishable. They, too, are very variable. The retractor muscles are stout and somewhat short in transverse section in both forms. In the variety it is possible to distinguish these belonging to the directive mesenteries from the others by their shape as well as by their position and orientation. In transverse section all have a reniform outline but those of the directive mesenteries are shorter and more nearly circular. In the typical form of the species this characteristic is not so marked as in the variety, but in the latter there is more space for the muscles to retain their natural outline than there is in the former. The retractor muscles in the variety become gradually more slender near the base of the column, and practically disappear before the base is reached. In the typical form, however, they extend along the basal disk almost to its centre, and play an important part in the muscularity of that structure.

The radial muscles of the disk and tentacles are at first sight difficult to detect, owing to the fact that they form a relatively narrow band in transverse section. In suitable longitudinal sections of the tentacles, however, they appear to be powerful and are easily distinguished.

Tentacles and disk.—

The arrangement of the tentacles is closely similar in the two forms, but the variety generally has one cycle fewer than the typical form, full-grown individuals of both being examined. Stoliczka said that he could distinguish the six primary tentacles from the others by their shape ; this I have been unable to do, but, at any rate in young individuals, their position surrounding the mouth is quite distinct and they are separated from the other cycles. Typically each cycle, commencing from the primary cycle and going outwards, has twice as many tentacles as the one immediately within it, as Stoliczka's diagram (*op. cit.*, pl. xi, fig. 2) shows very clearly ; but although this holds good as a general rule, there are many exceptions, which arise either from the suppression of some of the tentacles of a cycle or by the appearance of supernumerary tentacles. The latter phenomenon may occur in one of two ways : not infrequently an extra tentacle makes its appearance at the base of one already fully formed than which it is at first considerably smaller, and less frequently a tentacle splits longitudinally into two. I have seen both these methods of multiplication in

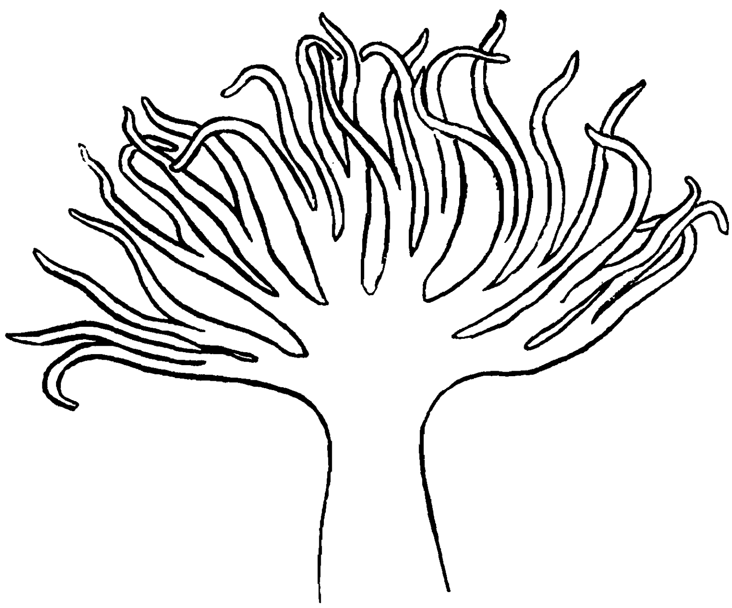


FIG. 2.—Expanded disk of *M. schillerianum* var. *exul*, oblique lateral view, nat. size.

progress in the variety, and have little doubt that they also occur in the typical form, judging from the slight divergencies from regularity which I have found in specimens.

As regards the individual tentacles I can find no difference between the two forms. In both they are elongated and tapering and are perforate at the free extremity. I have on one occasion seen an acontium protruded through the pore. The nervous layer of the ectoderm is clearly marked in transverse sections and the layers are generally of typical form and structure.

The wall of the disk is thinner in the variety than in the typical form. In the latter, when the disk is fully expanded its edge makes a right angle with the column and is entire. This is also the case as regards individuals of the new race of all ages, when their disks are fully expanded. When the disk of the typical form is partly contracted, however a fold of the wall of the column containing the upper extremity of the sphincter makes its appearance, and this is also the case in young individuals of the new race less than about 2 cm. long. Even after the appearance of this "collar," the margin of the disk is entire. In larger individuals of the isolated race, for reasons to be discussed immediately, the collar does not appear in any circumstance, and the margin of the disk is broken up by deep furrows into twelve lobes, each containing seven tentacles and every two corresponding to one of the six primary tentacles. As lobulation of the disk is generally regarded as a character of generic value in the group to which *Metridium* belongs, this is a matter of some importance. It must be noted, however, that the lobulation is not a permanent feature of the species or even of the new race, but only occurs in specimens of the latter which have attained a large size. Probably it is brought about by the nature of the radial muscles and the thinness of the wall. It is not in any way comparable to the shallower lobulation of the disk which characterizes many Actinians, but may be of interest in considering the question of the manner in which such permanent lobulation has come about.

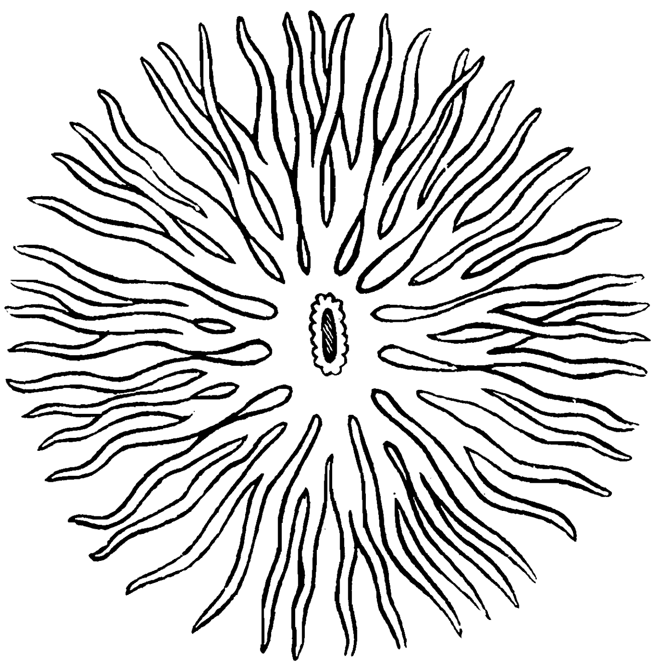


FIG. 3.—Expanded disk of *M. schillerianum* var. *exul.* from above, nat. size. Only the outermost cycle of tentacles is represented.

I have already referred to the fact that no fold makes its appearance round the disk of full-grown individuals of the var. *exul* when they are in the act of contracting, and also that contraction takes a different course in such individuals from that followed in the case of younger examples of the same variety or of either young or old examples of the typical form. When a full-grown typical individual is irritated, the whole disk is drawn downwards by the contraction of the contractor muscles, and at the same time, or a little later, the sphincter, by contracting draws in the upper part of the column above the disk, while the diameter of the disk and the length of the tentacles are reduced by contraction of the radial muscles, and the mouth is tightly closed. The tips of the tentacles are bent inwards in a broad arc. In young individuals of the variety the process is similar, but the sphincter contracts more strongly. The space in which the disk is to be contained is therefore less, and the tentacles are forced to dispose themselves in a different manner. The outer cycles draw together in such a way that their tips are in contact or almost in contact, while the inner cycles bend downwards and enter the mouth and stomodæum. The difference between the two ways in which space is found for the bestowal of the tentacles during contraction of the disk is strikingly illustrated in bisected specimens of the two forms. In full-grown individuals of the new race, on the other hand, the tentacles and the disk are not withdrawn entirely into the column when the animal is irritated, but, after partial retraction of the disk and contraction of the tentacles, the sphincter contracts below the disk and the mouth is closed, not always very tightly. This difference is connected with a change in habits which will be discussed later.

Basal disk.—

Not the least striking difference between the two forms is that connected with the basal disk; but as in other characters, the difference in this respect is more marked in fully grown individuals than it is in the young. The base of the typical form is strongly muscular, that of the variety much more feebly so; but that of young examples of the variety resembles, in its general characters, except in the absence of a sphincter, that of the typical form. In the typical form, the main axis of the base forms a right angle with that of the column, and the edge dividing them is sharply defined. It is possible, however, for the basal disk to be extended beyond the column under certain conditions, as when the animal is stationed in a cavity the diameter of which is greater, but not very much greater than that of its column. The lower surface of the basal disk is always flat as a whole. In young examples of the new race the lower surface of the basal disk is also flat; but the edges do not appear to be extensile. In well-grown individuals of this form, however, the lower surface of the basal disk is not flat, but either concave or convex in accordance with external circumstances. In fact, it has to a great extent lost its functions as an organ of adhesion, in accordance with the change of habits already alluded to. In both forms of the species, there is a pore in the centre of the basal disk, communicating on the one hand with the cœlenteron and on the other with the exterior.

In young examples of the new race there is a distinct folding of the ectoderm in the neighbourhood of the basal disk, comparable to that which occurs all over the column of the typical form; while a trace of folding can even be discovered in the former position in the adult of the isolated form. The arrangement of the inferior termination of the mesenteries is very variable in the new race, in which the two mesenteries of a pair often join together and end before reaching the centre of the basal disk, while sometimes they do not meet at all and run right to the edge of the central pore.

Mesenteries.—

The arrangement of the mesenteries in the typical form is, as is frequently the case in the family subject to many minor irregularities; but it seems to be a fixed rule in the species that only six pairs of mesenteries are complete, and that they are all, occasionally with one or two individual exceptions, fertile. The number of fertile secondary mesenteries is variable; often none of them are fertile, so that Stoliczka was right when he described specimens as having twelve ovaries. The mesenteries of the secondary cycles in this form are always smaller than those of the primary cycles, and the retractor muscles of the latter are so feebly developed that as a rule they are not visible to the naked eye. Mesenterial filaments, more or less perfect in structure, are usually present in those cases in which it is possible to recognize the retractor muscles; but some of the mesenteries, in all the specimens I have examined, consist merely of the basilar portion, with which they terminate, neither the membranous part between the proximal termination and the retractor, the retractor itself, nor the filament being represented. In the typical form of the species such imperfect mesenteries occur irregularly; in one specimen a pair was noted which seemed to represent by itself a cycle of which the other mesenteries were absent. In the new race, on the other hand, it is the rule for all the mesenteries except the six primary pairs to be in this rudimentary, or possibly vestigial condition. Only exceptionally do any of the secondary mesenteries bear retractor muscles, filaments or gonads. This condition of affairs considerably increases the lumen of the cœlenteron, which is further enlarged by another peculiarity namely the thinness of the mesoderm in the mesenteries. In the typical form of the species, this layer rather increases in transverse diameter as it juts out into the mesenteries, and maintains a porportionately considerable breadth the whole way between the basilar and retractor muscles. In the new race, however, although it bulges out and takes on a dendritic form in the region in which it supports the basilar muscles, it decreases greatly in thickness between the distal extremity of the latter and the base of the retractors. Indeed, to such an extent is this the case that in what may be called the membranous part of the mesentery, the mesoderm appears in transverse sections as an extremely delicate filament. There are, of course, differences in the transverse diameter of this layer, so far as the mesenteries are concerned, in different regions of the column; but the differences just described are very much more conspicuous than any of a local nature.

Both internal and external mesenterial stomata are present in both forms.

The structure of the mesenterial filaments calls for no special remark either as regards the species as a whole or as regards the two forms thereof. It agrees closely with that which has been described by O. and R. Hertwig (3), and subsequently by others, in the cases of different members of the Sagartiidæ. The only points in which these organs appear to exhibit specific interest so far as *M. schillerianum* is concerned, are the extent and number of the folds into which they are thrown both horizontally and vertically, and the great length of the acontia. I can detect no difference, except those already noted, as regards the structure of the mesenteries in the two forms of the species.

Gonads.—

The nature of the gonads in this species is interesting. In most

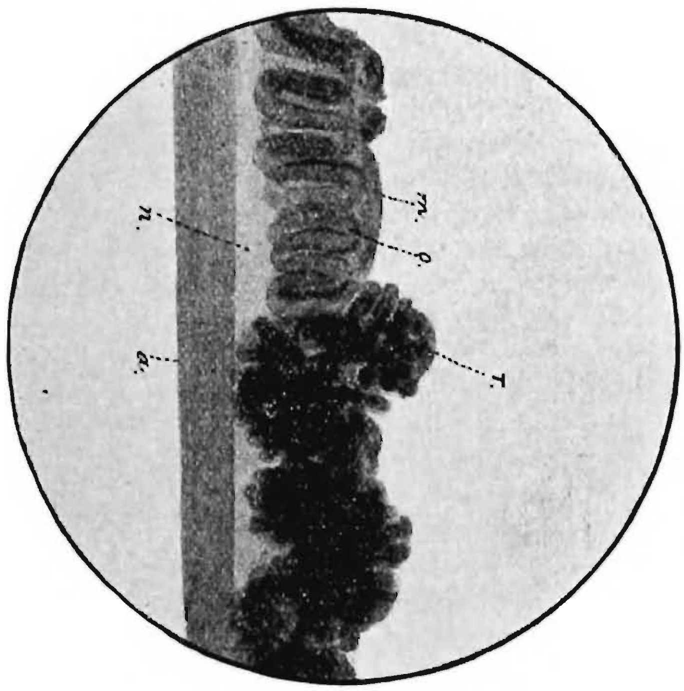


Photo by L. L. Fermor.]

FIG. 4.—Part of the mesentery of *M. schillerianum* var. *exul*, from a preparation in canada balsam, highly magnified. *m* = mesenterial filament; *t* = unripe testis; *o* = ovary; *n* = membranous part of the mesentery; *a* = retractor muscle.

of the Actinians one or other of two conditions is found—either the male and female organs are borne by different individuals, or the two are borne in the same part of the same mesentery of one individual, one sex generally taking precedence in time of the other. In *M. schillerianum*, however, neither of these conditions prevails. In specimens of the variety examined at the beginning of December, only ovaries (which were present in all individuals measuring more than about 15 mm. in length) could be found; they occupied the distal part of the mesentery, extending from the lower extremity of the stomodæum vertically downwards as far as the point at which the structure of the mesenterial filament first underwent a change. Their position on the complete mesenteries corresponded exactly, therefore, with that of the part of the filament which was trilobate in transverse section, and their lower extremity was situated exactly opposite the point at which the ciliated tracts of the filament disappeared. The lower part of the coiled portion of the filament, on the other hand, corresponded with a region of the mesentery containing, at that date, cells with all the characters of sexual cells but as yet of an indeterminate nature. These cells were situated at the base of the endoderm covering the mesentery. The ova were already far advanced in the part of the mesentery occupied by the ovary, and this part of the mesentery had lost its purple colour; but the lower part, below the ovary, was still of a very deep purple. The structure of the ovary closely resembled (except that the whole structure was strongly folded) that of the ovary of *Calliactis parasitica* as figured by O. and R. Hertwig (3). In specimens of the new race of *M. schillerianum* killed in January, however, the condition of the gonads had altered completely. The upper part of the mesentery was now devoid of ova and was thin and colourless; the lower part, in which the indeterminate sexual cells had occurred in other individuals a month earlier, was now distended with spermatozoa arranged in approximately quadrangular follicules. Although they were already ripe, the development of the testes had not destroyed the purple colour of this part of the mesentery. The structure of the organs was identical (except for a folding similar to that of the ovaries but even more marked) with that of the testes of *Calliactis parasitica*. In a few individual mesenteries the testes appeared to have invaded that region which had been previously occupied by the ovaries, but the two regions were as a rule distinct, and corresponded to those parts of the mesenterial filaments which I have referred to above. In individuals killed towards the end of March the gonads were again in the same condition as in those killed in December.

Stoliczka states that the eggs have a chitinous covering when emitted, and that there is a dark layer beneath this covering. If his statements are correct, both these structures must come into existence at a very late stage of development, for ova which appear to be of nearly full size show no trace of either. The spermatozoa, as Stoliczka noted, have a round head and a tail of somewhat moderate dimensions. In the testes they are arranged with their heads pointing outwards towards the endoderm which encloses them, and it appears that the movements of their tails prove sufficient to drive them through this endoderm, probably between the cells. Stoliczka's specimen, which threw out part of the gonad, was evidently living under unfavourable conditions, and the process appears to have been pathological. In individuals of the form he described living in my aquarium the gonads degenerated altogether. These individuals were obtained, together with others which were killed and dissected, in the Matla estuary at the beginning of January. The gonads of those which were examined were, at that date, in exactly the same condition as examples of the isolated race from the ponds.

Skeleton.—

In his account of the species Stoliczka stated that it was remarkable in the possession of a skeleton consisting of both calcareous and silicious elements. I have examined both his own specimens and fresh ones, in order to be in a position to discuss this skeleton; but in vain. All that I find is that in some of the individuals examined the cœlenteron is to some extent lined with extraneous particles of silica, which also occur in the mud of the ponds and estuary, and that these particles have occasionally been taken into the cells of the endoderm or even into the mesoderm. It is well known that many Actinians protect themselves by absorbing solid extraneous particles in this way, *e.g.*, the Indian species *Myractis tubicola*, Haddon (6). The calcareous spicule figured by Stoliczka looks very much like that of an Alcyonarian, and some of my specimens of *M schillerianum* var. *exul*, which were taken from the canals of a Sponge, contain undoubted sponge spicules.

Colour.—

Such coloration as the two forms of the species possess is practically identical and is due to three factors; two of these can be readily explained, while the origin of the third is still obscure.

The most general cause of colour is the presence of zooxanthellæ in the cells of the endoderm of the column and tentacles and of the ectoderm of the stomodæum. These bodies agree in form and structure with those found in other Actinians. In the new race of *M schillerianum*, and probably also in the typical form, they are not always present. I found at Port Canning in December that they were fairly abundant in individuals from one of the ponds, but were absent from others living in a second pond only divided from the first by a narrow bank. At the same time they were very abundant in examples of the typical form from the estuary; they be came far less numerous in the course of a few weeks in the same individuals, which were placed in an aquarium, but again reappeared in large numbers in their tissues before two months were past. The distribution of the zooxanthellæ in the tissues was found to be by no means constant. In individuals living buried in mud it was not surprising to find them practically confined to the tentacles and the upper part of the column. They were also noted occasionally in the mesoderm and even the ectoderm of these regions, and I have seen them on several occasions, as did also Stoliczka, in the cloud of slime and stinging threads shot out from the external surface when the animal was irritated. In the last instance there can be little doubt that they had been squeezed out accidentally. In individuals of the typical form they are as a rule more numerous in the endoderm underlying the sphincter and in that lining the interseptal spaces than elsewhere. They are not altogether absent from the intraseptal spaces, but are sparsely scattered in the cells. To this fact is due in part the presence of the semi-opaque vertical stripes which, in the typical form, represent the intraseptal spaces externally; but the difference between the character of the endoderm of these spaces and that of the interseptal ones is also, to some extent, responsible for this element in the coloration. In the pond race, the scarcity of zooxanthellæ in the column renders the wall of this region more transparent and makes it possible to distinguish the position of the mesenteries externally. The zooxanthellæ are always more numerous towards the distal end of the endoderm cells than at their base, from which, indeed, they are practically absent.

The second factor is not very important so far as coloration is concerned. It consists of irregularly shaped solid particles and globular masses of liquid, both very minute, occurring in the cells of the ectoderm of the stomodæum and the endoderm of the mesenterial filaments. Other particles, possibly of an excretory nature and of a shining white colour, are present in certain cells of the endoderm of the tentacles, giving rise to transverse bars. I can find no confirmation of Stoliczka's statement that these bars are due to accumulations of nematocysts, for nematocysts are equally numerous throughout the ectoderm of the tentacles. When zooxanthellæ are absent from an individual, the solid particles and liquid globules in the mesenteries and stomodæum give these organs a faint pinkish tinge during life. There can be little doubt that such intracellular accumulations of matter are direct products of metabolism.

The third factor is the cause of the purplish colour noted by Stoliczka in the mesenteries of the typical form, and equally conspicuous in some individuals of the new race, but not always present either in the typical form or the other. If any part of the endoderm of an individual with purple mesenteries be examined microscopically, it will be seen to contain numerous bodies of a deep violet colour. With the aid of a fairly powerful objective such as Zeiss' apochromatic D these bodies will be seen to vary considerably in shape and size and each to be enclosed in a green and apparently structureless capsule, the colour of which does not disappear in spirit. An oil-immersion lens is necessary to throw any light on their structure, and even under the highest powers they are minute. Under favourable conditions each body can, however, be seen to contain a large number of smaller, densely pigmented spherical structures, evidently spores, surrounding a colourless central core. I have not succeeded in investigating the structure of the spores owing to their minute size and to the fact that their dense pigmentation is extremely stable. The capsule is pear-shaped or subspherical in most of the bodies, but in the largest its outline becomes irregular; in some cases it is no longer intact and the spores are scattered round it. An examination of a considerable number of sections and other preparations has elicited the following facts as regards these violet bodies.

After the spores have been set free among the cells of the endoderm, they increase in size, and a small, comparatively clear circular space appears in the middle of each. In the centre of this space is a dot so minute that I have not been able to make out its structure. At first it is difficult to ascertain the nature of the envelope in which each of the spores is enclosed, but after they have increased slightly in size it is possible to see that each lies in a capsule resembling that of the parent but exceedingly delicate and only faintly tinged with green. At a slightly later period the capsule commences to bulge out at one pole, and finally forms a projection which may be either pointed or blunt at the free extremity, and is nearly as wide as, and several times as long as the body to which it is attached. It is apparently hollow, and a slight fold or constriction in its wall can generally be detected a short distance from the proximal end. The coloured contents of the capsule are still confined within their original limits, and as yet show no sign of subdivision. The main part of the capsule next increases in size and its contents split up, apparently by fragmentation, into numerous smaller bodies resembling the spore from which the whole structure originated but rather less minute, a colourless residue remaining. Some of these smaller bodies make their way into the hollow projection, and the main part of the capsule gradually becomes less distinct from the projection, which increases in girth; so that the whole structure assumes a pear-shaped or subspherical outline. During this process the products of division divide and become smaller by subdivision. Finally the capsule ruptures and a new generation of spores is set free.

It is obvious that much further study would be necessary before it would be possible to give a name to these violet bodies, and such study would have little bearing, so far as it is possible to see, on the subject of this paper. All that can be said is, that they appear to represent an asexual cycle in the life-history of some minute alga. It is of interest to note that if they are not phases of the same organism as the zooxanthellæ, two symbiotic, or at any rate inquiline, organisms occur together in the inner tissues of the same Actinian.

The position of the violet bodies in these tissues is practically the same as that of the zooxanthellæ, except that the former are inter-not intracellular. They are not, however, sufficiently numerous in the column to give a visible colour effect, and even in the mesenteries, in which they are far more numerous, they only colour the thin membranous part. Stoliczka believed that the deep purple, often seen in the region of the gonads, was directly due to the sexual products. So far from this being the case, I find that when the ovaries are ripe or nearly so, they lose their colour almost completely. The loss of colour, however, is due not to the entire disappearance of the violet bodies, but to the fact they are more widely separated from one another as the eggs increase in bulk and so stretch the endoderm in which the bodies are scattered. It is possible, however, that the growth of the eggs has some direct effect on these bodies, which are so scarce in the spent ovaries that the mesenteries have little colour in this region after the eggs are set free. I have not seen an immature individual with purple ovaries, and the violet bodies are always absent from the acontia.

From what has been said it is clear that neither form of *Metridium schillerianum* owes its coloration to pigment produced by its own metabolism. In both forms the colours are due to independent or semi-independent organisms, and the difference of distribution of these organisms in the bodies of the Actinians is probably connected with biological differences in the hosts.

BIOLOGY.

Relations to environment.—

Stoliczka found the original specimens of the species living attached to logs of wood ; he therefore suggested that they should be called Lignacalephæ. I have recently found specimens of the typical form ensconsed in the dead shells of barnacles fixed to iron posts in the Matla estuary. Stoliczka noted that the species, as he knew it, frequently inserted its basal disk into cavities in the logs to which it attached ; both in the case of my specimens and of his, the basal disk was extended somewhat beyond the periphery of the column to cover the base of the cavity in which the animal was stationed. In circumstances in which it is impossible for the Actinian to protect itself by entering a cavity already formed, for example when it is in a glass vessel, it constructs a protecting sheath for itself out of such objects as filaments of the algæ which grow in its natural habitat. This habit has been exemplified by individuals of both forms recently living in captivity in Calcutta, especially by fully grown individuals of the typical form and by young individuals of the new race. I was able, in the case of one example of the latter, to observe the production of the sheath. The animal had been removed from the aquarium and placed in a watchglass full of water, and was being examined under a fairly high power of the microscope. After a few minutes of complete contraction its column grew slightly longer and at the same time a large number of stinging-threads were emitted from the upper part of this region of the body. These were of simple structure, devoid of barbs. They did not remain still after being set free, but displayed a rapid corkscrew motion closely resembling that of many spermatozoa and were thus carried through the water for a short distance round the Actinian, from which they did not recede. A quantity of mucus was also secreted from the exterior of the column. The rapid movements of the threads did not last for more than a few minutes, but, as they ceased, the threads became matted together with the slime, which retained any extraneous substances that chanced to come in contact with it. Larger examples of the new race, examined as they were taken, had particles of the mud from which they had been removed adhering to them, probably for the same reason ; but in all cases the external coating thus formed was of an extremely evanescent and flimsy nature.

As I have already pointed out, there are few solid bodies at present to be found in the ponds at Port Canning I have searched them in vain for specimens of the typical form of the species, which was living in one of them thirty-nine years ago, when the logs of wood were there. Representatives of the new race now abound, however, in the ponds, with the exception of the two ponds nearest the railway station, both of which are used by the people of the settlement for such purposes as washing domestic utensils and clothes. (There is at Port Canning one large pond which is only separated from the brackish ones by a few hundred yards and yet contains fresh water ; but as the fauna of this pond is of normal character and does not include marine elements, I have not referred to it hitherto and need not do so again.)

Although the typical and the new forms of *M schillerianum* are alike in producing a temporary sheath of matter secreted by their own cells and mixed with extraneous substances, the new form is not in the habit as a rule of attaching itself by its base to the few inanimate solid bodies to be found in the ponds. *Spongilla cerebellata*, however, often occurs in masses of considerable size in the ponds, and in its canals I have found enormous numbers of young individuals of the Actinian. In the majority of cases these were situated in such a way that their long axes were parallel to those of the canals, to the walls of which they adhered by means of the external surface of their columns. In some cases, however, their basal disks were attached to the shells of small Lamellibranchs (*Corbula* spp.) which also frequent the canals of the Sponge. In situations in which no Sponges were present, the young of the Actinian were generally found attached to the filaments of algæ which formed more or less dense cloud-like masses, and many were also found among the matted roots of grasses. None, however, were found attached to the stems or branches of upright plants such as *Naias*, and it was clear that among the algæ and grass roots a considerable amount of lateral support was given them. When they were placed in a vessel of water without any such artificial support, they proved able to adfix themselves to the bottom by their bases and to stand upright with fully expanded tentacles. In this position they closely resembled the young of the common European *Sagartia troglodytes* and could only be distinguished from small examples of the typical *M schillerianum* by the greater elongation of their columns and by the thinness of the walls of this region—a feature quite apparent owing to the transparency of the tissues, which permitted the exact position of the internal organs and the movements of the acontia to be observed with ease. Individuals even in this stage, however, rarely lived for long in an aquarium, and at once gathered round them filaments of algæ.

The full-grown individuals of this new race were invariably found buried in mud, in which they were sunk as far as the base of the tentacles, and into which they retreated completely on being disturbed. When removed from the mud their long, vermiform columns were unable to support them in an upright position, and they lay in a glass vessel with their main axes parallel to the bottom, but with the extreme distal end of the column slightly curved upwards. Their attitude and appearance were in fact closely similar to those of many species of *Cerianthus* in similar circumstances. And yet every intermediate stage was to be found between the typical *Sagartia*-like young and the *Cerianthus*-like adult, while the internal anatomy, allowing for differences due to maturity, was found to be identical in large and small individuals. Moreover, although the basal disk had almost disappeared, it had not altogether lost its function as an organ of adhesion, for many large individuals dug from the mud were found on close examination to be adherent by their bases to shells and other small objects. In preserved specimens it would often appear on superficial examination that the basal disk is in much the same condition of atrophy as it is in *Edwardsia* and other burrowing forms, but in living examples it is always clear that this is not the case; in fact, a distinct disk is present (plate iii, fig. 3), but it is relatively small and in other respects degenerate.

Stoliczka noted that the typical form of the species was able to survive exposure to the sun out of water for some hours—a phenomenon which has been recorded in other Actinians—and I am able to confirm his observation. When exposed at low tide the animals remain with their tentacles extruded, and the whole organism has a particularly flabby appearance. A close examination of living specimens under these and other conditions, and a comparison with dead and carefully preserved material, enables me to suggest a reason for the powers of endurance possessed by the typical *M schillerianum;* possibly this explanation will be found to apply to other species also. I have already remarked on the comparatively thin walls of the column of the new race of *M schillerianum* as compared with those of the same part of the body in the typical form of the species, and on the fact that it is possible to gauge the thickness of the wall in small living specimens of the former owing to its transparency. The wall of the column in the typical form is usually less transparent than it is in the variety, owing to the large number of zooxanthellæ present in the endoderm; but this very fact makes it possible to estimate the extent to which the thickness of the wall is due to the layers other than the endoderm. This can be done most easily by watching an acontium which is being thrust out of one of the cinclides. It is not difficult to see that the thin white thread has to traverse a considerably greater extent of transparent tissue outside the coloured endoderm than could be accounted for if the thickness of the ectoderm and mesoderm seen in a transverse section of a preserved specimen were the same as the thickness of these same layers during life. The shrinkage, which is inevitable in preserved specimens, is very much more marked in the case of the typical form than in that of the pond race; it is less evident, in the case of the former, if specimens are killed and preserved in weak formol than if they are treated with reagents, such as corrosive sublimate and alcohol, which give a more satisfactory result as regards cellular histology. The reason for this apparently is that an aqueous solution of formol while causing intense muscular contraction during life, does not dehydrate the tissues after death. If a specimen of the typical form which has been preserved in formol be cut in two with a razor, so as to disturb the tissues as little as possible, it will be found that the ectoderm is not closely folded as it is in a specimen preserved in spirit or even in one which has been killed in formol and then dehydrated in alcohol and embedded in paraffin ; but that there are large spaces between this layer and the mesoderm, the two layers being only in contact at widely separated points and there being a considerable amount of liquid enclosed between them. The same condition, but not nearly to the same extent, will be found to exist in young individuals of the new form, while, except in the lower part of the column, it will not be detected in full-grown examples of this form. In the neighbourhood of the basal disk of these, however, it exists to a slight extent. In specimens of the typical form which have been long in alcohol, as I found in the types of the species, the ectoderm shrinks very greatly (apparently more so than the mesoderm does) and therefore comes to be nearly smooth again, lying parallel to the mesoderm. From these considerations I conclude that there is naturally a layer of water between the ectoderm and the mesoderm in the typical but not in the new form of *M. schillerianum*—there are traces of it even in the adult, and much more clearly in the young, of the latter—and further that the folds of the ectoderm which are so striking a feature of this layer in sections of the typical form (plate iii, figs. 5, 6) of the species, are artificial.

As to the function of this layer of water, which is confined to the column : I would suggest that it is to enable the Actinian to endure exposure to the sun out of water. The form is one which haunts tidal waters and, as Stoliczka noted, has a great tendency to maintain its position near the surface and to return to that position if removed from it. In the small cavities in which it is frequently found ensconced, a certain amount of water remains when the object in which they occur is left dry as a whole by the retreating tide. If the animal is able to make use of this water by drawing it into its body, as it may do by means of the cinclides, the habit of living in such cavities must benefit it in more ways than one. My reason for saying that it is possible that other species make use of subectodermal spaces in the same way as the typical form of *M schillerianum* is that I have observed in specimens both of this form and of *Sagartia troglodytes*, *Actinia mesembryanthemum* and other British species (especially when they are living under unnatural conditions in foul water) that blister-like projections appear on the column, most commonly towards its base, and that in the case of the Indian form these projections, which remain in specimens preserved in formol, are due to accumulations of liquid below the ectoderm. It is difficult to make observations as regards the exact relation of one layer of the body to another on living material, for the whole organism is so highly contractile that such relations are distorted immediately on the application of a sharp instrument to the external surface ; but water certainly exudes in considerable quantities from the wall of the column of a living example of the typical *M. schillerianum* which is cut with a razor.

The pond race of the Actinian is not subject to the same periodical exposure as the typical form of the species, for under ordinary conditions it lives beyond the reach of the tides. It is, however, exposed to gradual changes in the salinity of the water to which it is restricted. To what extent it is able to survive such vicissitudes is still uncertain[1]; if Stoliczka is right as regards the chitinous nature of the membrane which covers the egg of the typical form, and if the egg of the pond race has a similar covering, the egg is well fitted to withstand chemical changes in the environment, and even desiccation. Adults of the pond race are able to live for some hours lying on the ground exposed to the sun. Under such conditions their behaviour is totally different from that of examples of the typical form. I have found individuals of moderate size lying on the mud at the edge of a tank. Their tentacles were completely retracted and the sphincter was tightly closed; their columns were, however, distended with water, which was contained in the cœlenteron.

Under natural conditions both forms of the species are diurnal in habit, the typical form remaining with its disk fully expanded when exposed to the direct rays of the sun. The new race, however, is usually found below or among floating algæ according to its age, and these provide considerable shade. Young and half-grown individuals in my aquarium became practically nocturnal after a few days' exposure to bright light in a glass vessel. At night and early in the morning they expanded their tentacles, which were withdrawn as soon as the day became warm (*cf.* Fleure and Walton (12), p. 217). Individuals of the typical form living under identical conditions exhibited a similar tendency, but to a less marked degree; full-grown examples of the race never lived for at most more than three days in these conditions. Young examples of this form showed less power of resistance to the unnatural conditions of a small aquarium than did adults of the typical form, the latter living for over three months in water which was always kept of the same salinity, while those from the pools, in the same vessel, as a rule died in about a fortnight. The water in which they were, was taken from one of the ponds at Port Canning and was brought to Calcutta in a stoppered bottle.

Movements.—

Notwithstanding what appears to be an avoidance of bright light in the case of the variety, neither form of the species exhibits any marked heliotropism, negative or positive, in its movements. When individuals are placed in a glass vessel lighted from one side, they remain, other conditions being suitable, where they are placed, neither moving towards the light nor away from it. Stoliczka noticed, however, that his specimens showed a tendency to move upwards towards the surface of the water, and I find that mine prefer

---

[1] Almost at the end of the hot weather, the Actinian is still abundant in the ponds. May 27th, 1907.

to become stationary on the sides rather than at the bottom of the aquarium, unless they are given empty shells, in which they ensconce themselves at the bottom.

Both forms possess considerable powers of progression, but they do not habitually move in the same way. The only method I have seen the typical form adopt is that observed by Stoliczka *viz.*, by crawling slowly on the basal disk along a vertical or horizontal surface. This method of progression is effected partly by alternate contractions and expansions of the disk, and partly by a copious secretion of very tenacious mucus from the glandular cells which abound on this disk and round the base of the column. It is a slow and feeble one, as it generally is in Actinians ; Stoliczka records that a specimen in his aquarium moved 7 inches in 24 hours, while one in mine took three days and nights to move half the distance.

Possibly the young of the pond race may adopt the same method of progression occasionally, but as a rule they drag themselves along by their tentacles—a much more rapid method. A tentacle is stretched out to its greatest length, until it becomes filamentous. Some part of its surface is then applied to a fixed object, and a gland cell in the neighbourhood secretes a drop of mucous secretion, which fixes the tentacle to the object. The tentacle thus fixed contracts, dragging the whole animal forward as it does so ; the strain on its surface being considerable, the cells in the neighbourhood of the gland are drawn out into irregular projections at the points at which they are held by the mucus. Lately I have observed the same phenomenon in the tentacles of *Hydra*, and I have little doubt that this is the true explanation of Zykoff's statement that the ectoderm cells of the tentacles of *Hydra* put out pseudopodia which are used in progression (*Biol. Centralblat.*, xviii, p. 272, 1898). When the tentacle is dragged away after a forward movement of the organism, the false pseudopodia naturally appear in an exaggerated form ; they are not due directly to movements of the protoplasm of the cells, but to a mechanical strain on the external surface of these cells. I have been able to observe this method of progression in the case of very young individuals of the Actinian under a fairly high power of the microscope. Although the tentacles play in it the most important part, the walls of the column are also adherent to the surface along which the animal is travelling, and if it is moving vertically up the walls of an aquarium, as I have occasionally observed it to do, the "suckers" can be seen to be applied to the glass very closely. They do not appear to be at all markedly concave on the surface, however, as would be the case if they actually functioned as suckers.

In addition to this mode of progression with the aid of the tentacles and the surface of the column, individuals of the variety exhibit, at all ages, strongly marked muscular movements of the column wall. It is evident that the separation of the circular muscle of this region into separate circular strands is physiological as well as anatomical, for it is possible for each strand to contract independently of the others, so that the column appears just as though an extremely fine thread were drawn tightly round it at one point (see plate iv, figs. 3, 4). Although any one of the strands can contract in this way without affecting the others, I have observed under the microscope that they very frequently contract rhythmically and in regular succession from below upwards. What happens is this: The pore in the centre of the basal disk is opened and water is drawn into the lumen of the disk, which becomes bulbular, the circular muscle strands at the base of the column being strongly contracted above it. Then the pore is closed, the lowest muscle strand relaxes and the second one above it contracts. Then the second strand relaxes and the first contracts again, and, as the process is continued up the column, the water is gradually driven up towards the mouth, just as though it were being squeezed upwards in an indiarubber bag by drawing tight and loosening in regular succession a series of elastic rings. I have little doubt that it is by such means that the Actinian is able to rise to the surface again after it has sunk into the mud; but I have only been able to observe such movements in the case of young individuals which had not yet begun to burrow. In their case the movements assisted them in making their way through a tangled mass of alga filaments. The foot of adult individuals of this variety is probably used for burrowing, aided by contractions both of the circular and the retractor muscles; but owing to the difficulty experienced in keeping such individuals in a healthy condition after they have been removed from their natural habitat, I have no direct observations to offer on this point. When large individuals are removed from the mud, the contractions of the column which take place are very marked, but entirely lack co-ordination.

Food.—

Judging from dissected specimens, the food of the pond race consists very largely of minute univalve Molluscs, the shells of which are ejected after the animal has been absorbed, and of small fish such as *Haplochilus melanostigma* and *Gobius alcockii*. Stoliczka found that the typical form eat Crustacea in captivity, but I have no information as to its natural food.

RELATIONS OF THE VARIETY TO THE TYPICAL FORM.

In order to make this question clear it will be well to commence its discussion by summarizing the resemblances and differences between the two forms (*a*) as regards their physical structure, and (*b*) as regards their habits.

Physical resemblances between the two forms.

1. The coloration is practically identical.
2. The arrangement of the tentacles and mesenteries is the same.
3. The position of the circular and radial muscles is the same.
4. The structure and nature of the gonads are the same.
5. The retractor muscles are closely similar.

6. The outline of the sphincter is almost the same.
7. The number and position of the mesenterial foramina are the same.

Physical differences between the two forms.

1. The column is much longer in the variety than in the typical form.
2. Its wall is thinner during life.
3. There is one cycle of tentacles and mesenteries less in the variety than in the typical form.
4. A larger number of mesenteries are usually rudimentary in the variety than in the typical form.
5. The mesoderm of the mesenteries is thinner in transverse section in the variety than in the typical form and a larger number of mesenteries are degenerate.
6. There is no basal sphincter in the variety.

In these lists only the resemblances and differences which appear to be constant throughout life are noted. The following are differences which are only apparent in full-grown individuals :—

1. There are no muscle spaces in the sphincter of the typical form, while these spaces occur in small numbers in the adult of the variety but are absent in its young.
2. The adult of the variety is unable to withdraw its tentacles into its body, while the young of the same form and the adult of the typical form can do so.
3. The adult of the variety is unable to stand upright on its base, while the adult of the typical form and the young of the variety can do so.
4. The disk of the adult of the variety is broken up into lobes; but this is not the case in the young of the same form or the adult of the typical one.

Biological differences between the two forms.

The habits of the two forms are totally unlike. The typical form lives in tidal waters, attached to solid objects; but it was also found formerly in an isolated pond. The variety is apparently confined to isolated ponds, the water of which sometimes contains as little as 0·22 % of soluble solids ; the young live among grass-roots and filamentous algæ, or in the canals of Sponges, the adults buried in the mud. Individuals of the typical form can live in water of the same salinity as that of the isolated ponds in which the variety occurs but are not now found in these ponds, from which the solid objects to which they were formerly attached have disappeared. The movements of the variety are more active than those of the typical form, in accordance with the different mode of life adopted.

The most striking differences externally visible between the two forms are the great relative length of the column and the degeneracy of the basal disk in the pond race. I do not know of any other form of the genus in which these characters are so strongly marked; but many instances among the Actiniaria could be adduced in which there is a considerable tendency to variation as regards them. Anyone who has observed living examples of the common British *Sagartia troglodytes* from different parts of the country, or even from different situations in the same locality, must have been struck by the differences they exhibit as regards the form of the column and the relative proportions of its base. Those individuals which have been extracted from small crevices in rocks have a long, thin column and a base with a small transverse diameter, while those from pools with smooth bottoms are short and squat. In Gosse's *History of the British Sea-Anemones* (1) figures are given of the species in the latter condition. As regards outline at any rate, these figures are accurate; but they are as unlike as they could well be to some individuals I have seen. Moreover, I have noticed that in such cases the column cannot adapt itself, except to a limited extent, to new conditions, even although the individuals may be kept alive for many years in captivity. Those individuals which have been living in small round holes such as are a favourite station for the species, cannot assume the depressed conical form that characterizes those which have been fixed to a smooth surface; but those which have been taken from the latter situation are able to elongate their columns considerably and to draw in the projecting margin of their bases. In other British species differences, which may be local, have been recorded, *e.g.*, Dixon (5) states that specimens of *S. nivea* from the east coast of Ireland are much longer and more attenuated than those described from Torquay, on the south coast of England, by Gosse. From Indian seas Alcock (7) has described a variety of *Sphenopus arenaceus* in which the base of the column is drawn out into a relatively long and narrow peduncle.

In none of these cases has the basal disk become degenerate to the same extent as it has done in the tank form of *M. schillerianum*, for there is no basal disk in the genus *Sphenopus*; but in other respects the variation seems to be of a similar nature. It must be remembered, moreover, that there is a great difference, in respect to the condition of the base, between the young and the adult of *M. schillerianum* var. *exul*, as well as in respect to the proportions of the column. It must further be borne in mind that this Actinian lives in a medium the chemical constitution of which is different from that of the medium proper to its class, and there is very good reason to believe that a chemical stimulus may be a powerful one in matters of variation. The particular direction which evolution has taken in respect to this isolated race, moreover, is one which has not been uncommon in the history of the sub-class to which *M. schillerianum* belongs, for we get forms as distinct from one another morphologically as *Edwardsia*, *Cerianthus* and *Peachia* all adapted in a similar manner to become burrowing animals, and all in consequence having a considerable external resemblance both to one another and to the form under consideration.

The differences which the two forms of *M. schillerianum* exhibit as regards their muscles and mesenteries are perhaps of more importance, from the point of view of the systematist, than the differences in the general appearance and shape of the animals. The muscular differences, however, all seem to be what may be called rather dynamical than morphological. The position of the muscles as regards the layers of the body is identical in the two forms, but in var. *exul* they appear to have become strengthened in certain directions and weakened in others, in accordance with a complete change in the mode of life. Although the mesoderm of the mesenteries is much thinner in the new than in the typical race, and the secondary mesenteries are in a much earlier stage of development as regards their whole form and structure, I think that a similar explanation is possible, for this change is, like that of the muscles, one of development. The mesenteries have not evolved new characters in the isolated race but remain throughout life in a condition through which they pass at an early age in the typical form, and it is obviously a convenient condition as regards the bionomics of the race. This explanation does not quite apply to the thinness of the mesoderm in mesenteries which are just as long as they are in the typical form of the species; but seeing that one of the most striking biological modifications of the isolated race is the use to which it puts the liquid contained in its cœlenteric cavity, it is not difficult to see that the pressure of this liquid must have, in the case of the individual, considerable influence on the growth of the mesenteries.

It is noteworthy that those structures which have the same function in the two forms have undergone very little change in the isolated race. This is particularly true of the tentacles and stomodæum. Indeed, the last-named structure offers so little of interest in connection with the special line of study embodied in this paper, that I have barely referred to it except in the brief systematical description of the two forms. I ought to say, however, that while it is actually longer in the case of a full-grown example of var. *exul* than it is in one of the typical form of the species, the elongation is by no means proportionate to that of the columns as a whole. The reduction in the number of tentacles and mesenteries exhibited by the isolated race, is clearly related to its narrow, elongated form.

In dealing with the question of the modifications which the Actinian of the Port Canning ponds has undergone, it is not by any means easy to apportion the degrees in which these modifications have affected (*a*) the individual and (*b*) the race. It is known that individuals of the same family (*e.g.*, in *Sagartia troglodytes*) have lived for over fifty years (see Ashworth and Annandale [9]), but such instances, as Hickson (11) has recently pointed out, are only known in the case of captive specimens, which have received regular food and lived a sheltered life. Considering the vicissitudes to which they are exposed in the ponds at Port Canning, it is very improbable that any of the individuals now living in these ponds have survived for so long a period, while the presence of numerous young in the ponds and of ripe gonads in the adults proves that we are dealing with a race and not merely a collection of infertile individuals. The modifications are undoubtedly less marked in the young than they are in their parents, between which and the typical form the young are intermediate. This is true as regards biological as well as structural characters. The youngest individuals of the typical form I have seen (measuring about 4 mm. in height) have had a considerably shorter column than examples of the isolated race with disks of a smaller diameter.

Variation has been little studied in the Actinians, which do not make satisfactory specimens either for the museum or the laboratory; but the stony corals, in which the skeleton preserves in many respects a complete diagram of the living tissues, prove how variable certain genera and species of Zoantharia can be (for example see Bernard on *Porites* in the *Catalogue of the Madreporarian Corals in the British Museum*, vol. v, 1905). I doubt whether Gosse was so far from the truth as later systematists believe him to have been when he laid stress on the importance of the study of the living organism in the case of the Actinians. It is worthy of note that, at any rate as regards the Sagartiidæ, the descriptions of genera have recently shown a tendency to become more rather than less indefinite. Compare, for example, Hertwig's (4) definition of *Sagartia*, published in 1882, with Haddon's (8), published in 1898, or with McMurrich's (10), published in 1905, having regard to the fact that these authors are in substantial agreement as to the species which should be included in the genus. As the three diagnoses are short, they may be quoted in full :—

> " *Sagartiidæ* with smooth walls and numerous powerful tentacles arranged in several rows; with circular oral disk; without anatomically perceptible cinclides." (Hertwig, 1882.)

> " *Sagartiinæ* with a smooth body-wall, or with small verrucæ in the upper portion of the column; moderately long tentacles in several cycles around the margin of the oral disk, which is not greatly expanded." (Haddon, 1898.)

> " *Sagartiinæ* with the column smooth or provided with verrucæ in its upper portion; cinclides more or less scattered; acrorhagi wanting; margin not lobed." (McMurrich, 1905.)

The diagnoses of the family and sub-family given by these authors are still more diverse, but the point I wish to bring out is the way in which various descriptions illustrate the necessity felt by recent authorities for broadening the diagnoses of Actinian genera.

Granted that *Metridium schillerianum* var. *exul* is an isolated race of the species to which I have referred it, it still remains to be discussed whether this race has become differentiated in the ponds at Port Canning, and how long the process of its evolution has taken to reach the present stage. The historical evidence on these points, although it cannot be called absolutely conclusive, is much stronger than such evidence usually is. Stoliczka's account of the typical form of the species was written in 1868 (at which date the extent and number of the ponds were probably not the same as they are today) and was more detailed than any dealing with the Sagartiidæ which had previously appeared, although it contained a number of misconceptions rather than errors of observation. Its author was a trained and cautious observer and apparently examined the ponds at more than one time of year. It is improbable that he only did so on occasions when the water had been rendered turbid by rain. Except under these conditions he could not have failed to see the Actinians, had they occurred in the ponds; nowadays they are the most characteristic feature of the fauna to which they belong, and strike even a casual observer. Native fishermen at Port Canning volunteered the information, when I asked them about the fish in the ponds, that there was in the mud " an animal just like a flower." It is unfortunate that we do not know in which of the ponds Stoliczka found the Actinian, but I suspect that it was the one nearest to the railway station. Its usage for domestic purposes has now rendered the water of this pond foul. Stoliczka said that the Actinian did not live in the other ponds at Port Canning because they did not contain logs of wood, and because their water was unsuitable. The last statement is not explained. The logs of wood no longer exist, and their place has not been taken by other solid substances to which the animals might have attached themselves. It has been shown that the race of the Actinian now found in the ponds does not attach itself to fixed bodies, but has become adapted for a burrowing life. So far as the neighbourhood of Port Canning is concerned, I feel sure that this new race is only to be found in the ponds; but our ignorance of the Actiniarian fauna of the Indian seas makes it impossible to deny that an identical form may occur elsewhere. Even should this prove to be the case, however, it would not necessarily be uncritical to argue that similar causes have produced convergence among the offspring of different individuals.

However, it is perhaps better not to introduce questions of possibility; my object in this paper has been to give an unbiassed account of the differences and resemblances between two Actinians which I take to be no more than races of a single species. One of these races has been isolated in certain small ponds, in which it appears to have responded to its environment to such an extent as to have altered very considerably both its structure and its mode of life.

LITERATURE.

1. Gosse, P. H. — "A History of the British Sea-Anemones," 1860.
2. Stoliczka, F. — "On the Anatomy of *Sagartia schilleriana*," etc., *Journ. Asiat. Soc. Bengal*, part 2, xxxviii, 1869.
3. Hertwig, O. and R. — "Die Actinien," *Jen. Zeitschr. f. wiss. Zool.*, xiii, p. 457, 1879.
4. Hertwig, R. — "Actiniaria," *Zool. Rep.* H.M.S. "*Challenger*," vol. vi, 1882.
5. Dixon, G. Y — "Remarks on *Sagartia venusta* and *Sagartia nivea*," *Proc. Roy. Dublin Soc.*, vi (N.S.), 1888.
6. Haddon, A. C. — "Two species of Actiniæ from the Mergui Archipelago," *Journ. Linn. Soc.*, xxi, 1889.
7. Alcock, A. — "Some Actiniaria from Indian Seas," *Journ. Asiat. Soc. Bengal*, part 2, lxii, 1893.
8. Haddon, A. C. — "The Actiniaria of the Torres Straits," *Sc. Trans. Roy. Dublin Soc.* (2), 1898.
9. Ashworth, J H., and Annandale, N. . — "Observations on some aged specimens of *Sagartia troglodytes*," etc., *Proc. Roy. Soc. Edin.*, xxv, 1904.
10. McMurrich, J P. .. — "The Actiniæ of the Plate Collection," *Zool. Jahrb.*, Suppl vi, 1905.
11. Hickson, J J. — "Cœlenterata and Ctenophora," *Cambridge Natural History*, vol. i, 1906.
12. Fleure, H. J., and Walton, C. L. — "Notes on the Habits of some Sea-Anemones," *Zool. Anz.*, xxxi, 1907.

(Only those works which are directly referred to in the text are noted in this list. Full bibliographies on the group will be found in papers Nos. 8 and 10, while several species are recorded for the first time from Indian seas by Southwell in Herdman's "Faunistic Results" in *Ceylon Pearl Oyster Fisheries and Marine Biology*, part v, p. 441 (1906)).

PLATE III.

EXPLANATION OF PLATE III.

Figs. 1, 2.—Typical form of *Metridium schillerianum*, ×1 (after Stoliczka).

Fig. 3.—Pond race of *Metridium schillerianum* in a contracted condition, ×1 (*ad nat.*).

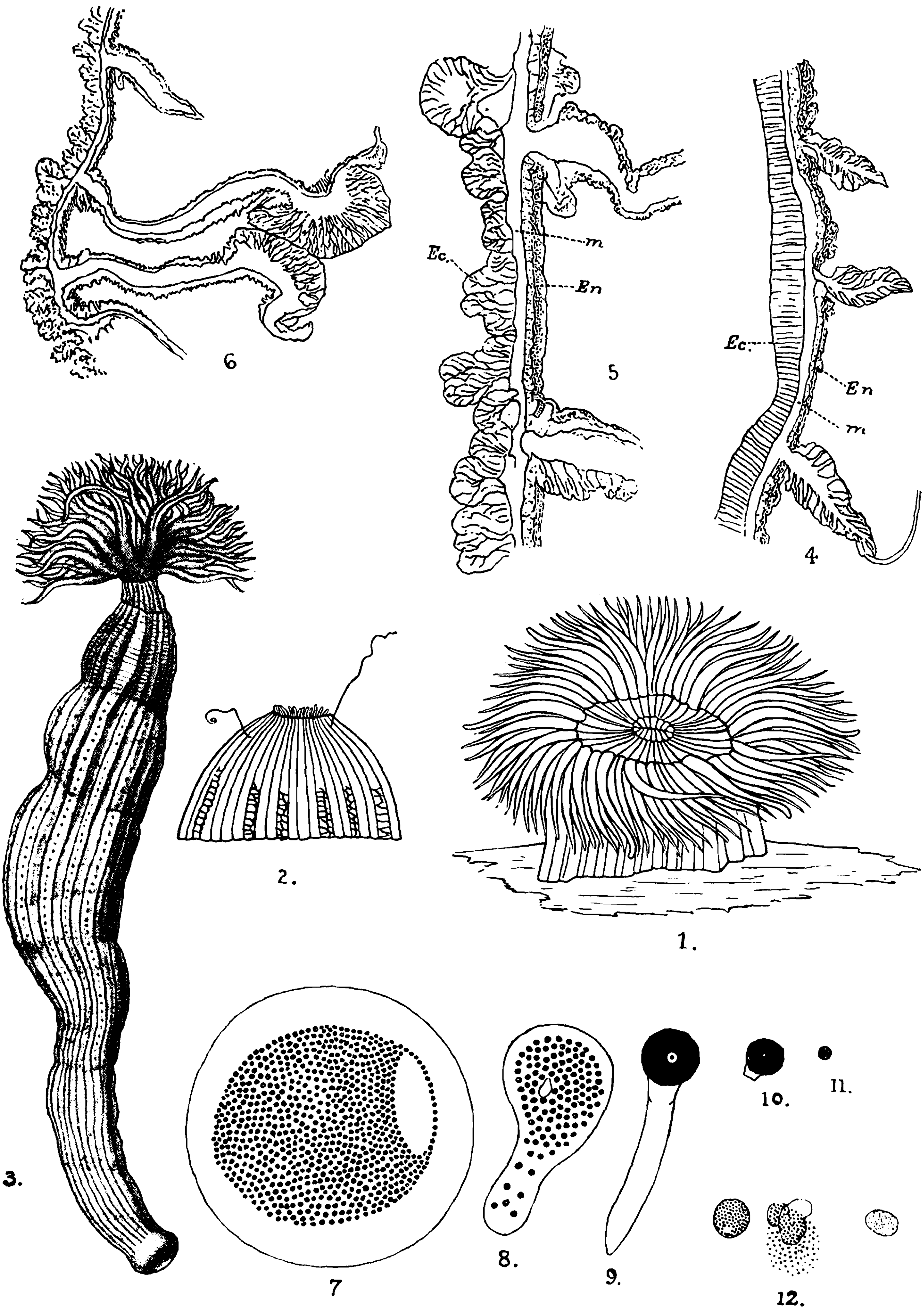
Fig. 4.—Transverse section of wall of column of *M. schillerianum* var. *exul* in the region of stomodæum (magnified).

Fig. 5.—Transverse section of wall of column of the typical form of *M. schillerianum* (at the same magnification as fig. 4).

Fig. 6.—Ditto (less highly magnified).

Figs. 7–12.—Stages in the development of the violet bodies of *M. schillerianum* (enormously magnified). Figs. 7–11 are diagrammatic.

Ec.=ectoderm: *en.*=endoderm: *m.*=mesoderm. The endoderm in the figures is apparently divided into two layers, but this is due to the almost complete absence of zooxanthellæ in the basal part of the cells.


6
5
4
m
Ec.
En
Ec.
En
m
3.
2.
1.
7
8.
9.
10.
11.
12.

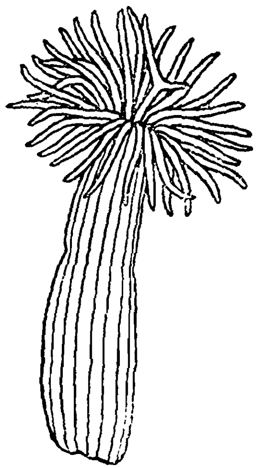


FIG. 1.

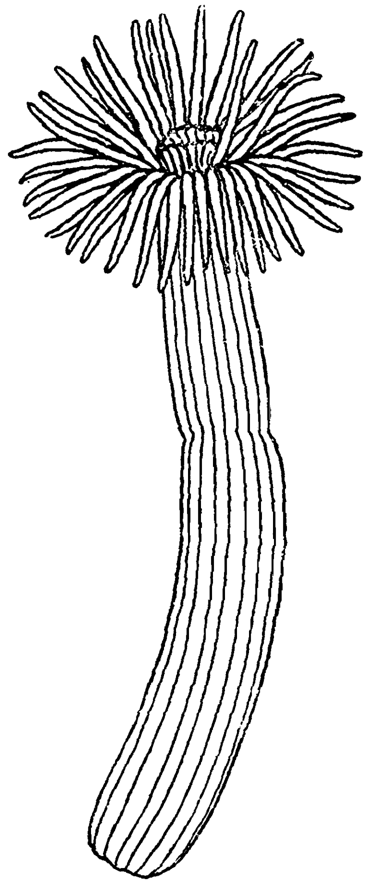


FIG. 2.

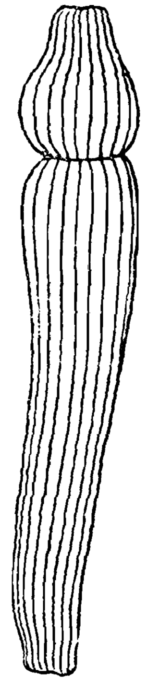


FIG. 3.

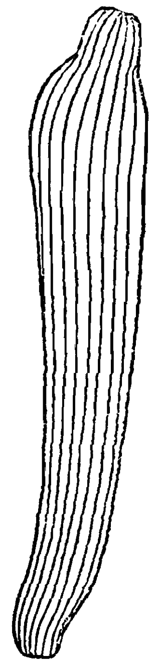


FIG. 4

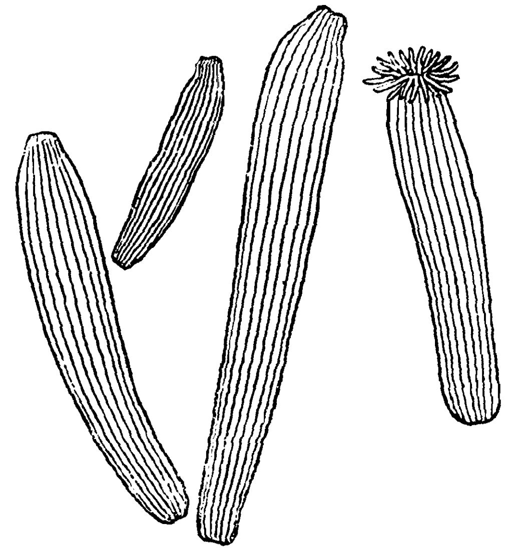


FIG. 5

YOUNG INDIVIDUALS OF *Sagartia schilleriana* var. *exul* IN DIFFERENT STAGES OF CONTRACTION, all × 4.

Fig. 1 represents an individual which is rather shorter than usual just beginning to expand its tentacles. One of the tentacles is dividing longitudinally. Fig. 2 shows a slightly older individual in which the tentacles are more nearly but not quite fully expanded. Note the open mouth from which the inner tentacles have just been withdrawn. Figs. 3 and 4 represent the same individual in a contracted condition, fig. 3 having been drawn about five minutes later than fig. 4. Fig. 5 shows a group of still younger individuals, all having pressed themselves against the side of an aquarium. All the specimens figured were standing upright.

A SPOROZOON (*SARCOCYSTIS*, SP.) FROM THE HEART OF A COW IN CALCUTTA.

By G. C. CHATTERJEE, M.B., *Assistant Professor of Pathology, Calcutta Medical College.*

In searching for Pirosoma in a blood-smear from the heart of a cow killed in Calcutta, I lately found numerous sickle-shaped bodies which were at first sight very puzzling. These bodies took the Leishman stain, with which the smear was stained, very well. One end, however, took no stain, this end being pointed. The other end was rounded and stained deeply, taking the blue stain. In this end a not very definite nucleus could be made out, and a number of red-stained chromatic dots. The middle of the body stained red deeply. The appearance of these bodies suggested that they were spores of some Coccidium, and on referring to Minchin's (A) account of the Sporozoa in Lankester's *Treatise on Zoology*, the resemblance between them and the spores of *Sarcocystis tenella* (*op. cit.*, p. 305, fig. 122) was at once evident.

In part of the smear a considerable number of straight forms were seen, and in addition to these, two varieties of spores could be made out, being differentiated from one another by the arrangement of the chromatic dots. In a few cases the capsule was found to have burst and the contents were escaping.

On making a section of the heart muscle of the same animal as that from which the smear had been made, and on staining this section with thionin and eosin, my supposition that the bodies were spores of some Sporozoon was confirmed, for numerous cysts were found occupying the substance of the muscle. These took the blue stain, while the rest of the tissue took the eosin. On examining the sections under a high power, I found that the cysts occupied the substance of the muscle fibres, displacing the nucleus. A distinct capsule was a noticeable feature of the cyst. No fine radiation, however, such as is found round the capsule of *Sarcocystis tenella*, could be detected. The identity between the spores, numbers of which occurred in each cyst, and those seen in the smear was evident. The spores were found grouped in loculi, but no distinct alveolar partition could be made out. All the cysts were in the same stage of development, and no intermediary stages were found.

Representatives of the Sarcosporidia are not very uncommonly found in the striated muscle-fibres of Mammals, especially in those of the pig and the sheep. That found in the sheep goes by the name of *Sarcocystis tenella*. One has been found by Hessling in the skeletal muscle of *Bos taurus*. Vuillemin (B) reports a case of infection in the muscle of a man and is of the opinion that the parasite was *S. tenella.* Von Linstow (C) has described a form (*Balbiana* (*Sarcocystis*) *siamensis*) from the tongue of a buffalo in Lower Siam, and Shipley (D) has figured this form. Shipley (E) has also described another form from the muscle of a cow in Ceylon, regarding it as identical with *S. tenella.* Willey, Chalmers and Phillip (F) report frequently infection in the voluntary muscles of buffaloes which are apparently healthy. They found the parasite in 5·8 per cent. of the individuals slaughtered in Colombo.

Regarding the classification and nomenclature of the Sarcosporidia found in different animals, there is a great deal of confusion, as an illustration of which I cannot do better than quote Minchin's remarks (*op. cit.*, p. 308) on the subject. "*Sarcocystis*, Ray Lankester, 1882," he says, "represents the characters of the order. A great number of forms have been seen in different animals, many of which are probably distinct species, but only a few have received specific designation: such are *S. miescheriana* (Kühn) from the pig; *S. tenella*, Raillet, from the sheep; *S. platydactyli*, Bertram, from the gecko; *S. muris*, Blanchard, from the mouse, etc."

21st February, 1907.

LITERATURE.

A. Minchin on the Sporozoa in Lankester's *Treatise on Zoology*, part i, fasc. ii, 1903.

B. Vuillemin, *Compt. Rend. de l'Acad. des. Sci. Paris*, cxxxiv, No. 20, p. 1132, noted in Baumgarten's *Jahresbericht* for 1905.

C. Von Linstow, "Parasiten, meisten Helminthes, aus Siam," *Archiv. f. Micr. Anat.*, Bel. lxxii, 1903.

D. Shipley, on the Ento-parasites collected by the Skeat Expedition in the year 1899-1900, *Proc. Zool. Soc.*, 1903 (2).

E. *Idem*, "Some Parasites from Ceylon," *Spolia Zeylanica*, vol. i, 1903.

F. Willey, Chalmers and Phillip, "Report on parasites in the carcases of buffaloes at the Colombo Slaughter-house," *Spolia Zeylanica*, vol. ii, 1905.

MISCELLANEA.

MAMMALS.

THE APPENDICULAR SKELETON OF THE DUGONG (*Halicore dugong*).—In a recent note on the Dugong of the Gulf of Manaar (*Journ. Asiat. Soc. Bengal*, 1905, p. 238) I expressed an intention of dealing with certain anatomical points in a subsequent communication. As, however, most of these points have since been elucidated in a series of memoirs by Messrs. H. Dexler and L. Freund (see Wiegmann's *Archiv fur Naturgeschicte* for 1906, vol. i, p. 77, and the *American Naturalist*, vol. xi, pp. 49 and 567, 1906), further descriptions are unnecessary : these authors' observations were made on Australian specimens, but I cannot detect any constant difference between the races of *Halicore* found in Australian and in Indian seas. There are two features in the skeleton, however, to which I would like to invite attention, namely (*a*) the presence of three distinct bones in the pelvic girdle, and (*b*) the variability of the manus.

(*a*) In recent accounts of the vestigial pelvic girdle of the species two bones are said to be present (see Weber's *Die Saugetiere*, p. 732, fig. 526). In a large Australian ♂ skeleton, however, and in an individual of the same sex and approximately the same size dissected by myself on the Madras coast, I find that there is a third bone, which lies at the distal extremity of the lower of the two

FIG. 1, × $\frac{1}{8}$.

already recognized. It is compressed and nail-shaped, measuring about 15 mm. in length and 6 mm. at the proximal end in breadth. The relations of the three bones to one another are represented in the accompanying diagram (fig. 1). There is probably a considerable amount of variation as regards the form and size of the three bones, but this is a question on which the material at my disposal affords little information.

(*b*) I have examined the manus of the two specimens already referred to, as well as that of several other individuals in which it is imperfect, while I am indebted to Sir William Turner and Prof. D. J. Cunningham for photographs of a specimen in the Anatomical Museum of the University of Edinburgh and to Dr. A. Willey for a sketch (fig. 4) of the hand of an adult female in the Colombo Museum. An examination of this material proves, as is well shown in figs. 2, 3 and 4, that the bones vary in number and relative development

Although all the specimens I have seen, or regarding which I have received detailed information, have been fully adult, probably measuring between nine and ten feet in length in the flesh, the degree to which ossification has progressed is very variable and the hand seems to be smaller in some individuals than in others of the same size. The first digit is always less well-developed than the others. In some individuals it consists of a short oblong or triangular bone, often more or less irregular in outline; in others in which it is represented by

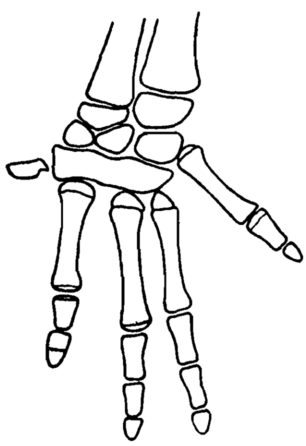


FIG. 2, $\frac{1}{6}$.

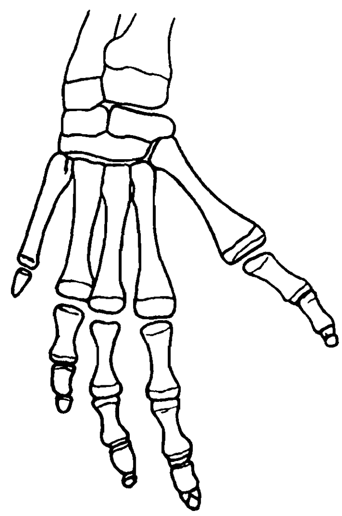


FIG. 3, $\times \frac{1}{6}$

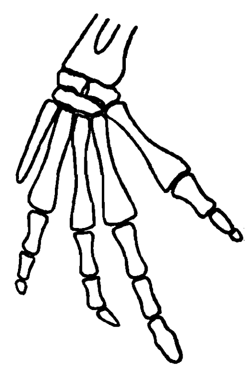


FIG. 4, $\times \frac{1}{6}$.

a single bone, this bone is long and styliform; while in others again there are two bones, the distal one being short and nail-shaped. The other digits show similar variations but not to the same extent. The bones of the carpus vary chiefly as regards anchylosis. Those in the distal row are used together, probably in all cases; but in the proximal row there may be either two or three bones present. In the latter case it is the scaphoid which is distinct from the lunate bone. The figures, which are outlines of actual specimens reduced to one-sixth the natural size, illustrate these variations very clearly, fig. 3 showing, further, the actual relations between the fourth and fifth digits—a feature which is not always correctly represented.

N. ANNANDALE.

BIRDS.

EGG LAID BY A CAPTIVE GOSHAWK (*Astur palumbarius*).—Lieutenant-Colonel Phillott has recently sent to the Museum the egg described in the following note. It measures 50 mm. in length and 40 mm. in greatest transverse diameter; the colour is a clear, pale green, the outline regular.

"My friend Miyān Mahmūd Sahib-zada of Taunsa, Dera Ghazi Khan, has sent me a Goshawk's egg laid by a trained bird which had been in confinement for sixteen years and was, when caught, a 'hagard' or mature bird. This is the first egg she has laid in captivity. It is very like a heron's egg and has a coarse shell, being without markings.

D. C. PHILLOTT."

FISH.

MELANIC SPECIMENS OF THE PUTIA (*Barbus ticto*).—The Putia is a small Cyprinine fish very common in ponds throughout India. The normal coloration is given by Day (*Faun. Ind., Fishes*, i, p. 325) as " silvery, sometimes stained with red, a black spot on the side of the tail before the base of the caudal fin and immediately behind the anal; a smaller one (frequently absent) at the commencement of the lateral line. Fins often black, sometimes orange." A number of specimens recently obtained from a tank at Rampur Bhoolia in the Rajshahi district of Eastern Bengal, show a varying tendency towards melanism. In some individuals this is barely perceptible, but in some the edges of the lateral and the whole of the ventral scales, the dorsal surface of the head and the fins (especially the pelvic, anal and dorsal) are more or less densely suffused with black. This is less noticeable in the region between the anal fin and the caudal spot, which is faintly ringed both in these and in normal specimens with cream-colour. The region below the caudal spot can be seen to be slightly paler than the rest of the body even in normal individuals, if they are examined alive; but its paleness is more striking in melanic examples. In none of those from Rajshahi can the anterior spot be distinguished; the fins of the paler individuals are almost colourless.

Day gives the number of horny rays in the dorsal fin as 8; it is just as frequently 7.

N. ANNANDALE.

CRUSTACEA.

TWO BARNACLES NEW TO INDIAN SEAS.—The following Cirripedes do not appear to have been recorded hitherto from the seas of India:—

Pœcilasma gracile, Hoek.

Several specimens from the spines of an Irregular Echinoid dredged by the Indian Marine Survey off the extreme south of India (Lat. 8° 37′ N., Long. 75° 37′ 30″ E.) from a depth of between 224 and 283 fathoms. The species was originally obtained by the 'Challenger' off Australia from a depth of 410 fathoms.

Pœcilasma eburneum, Hinds.

Several specimens from the spines of an Echinoid of the family Cidaridæ, dredged by the Indian Marine Survey in the Persian Gulf from a depth of between 48 and 49 fathoms. The species was described from New Guinea. The specimens here recorded, as well as those of *P. gracile*, were attached to the spines surrounding the mouth of the Echinoid on which they occurred.

N. ANNANDALE.

INSECTS.

MOSQUITOES OF THE GENUS ANOPHELES FROM PORT CANNING, LOWER BENGAL.—At Port Canning, on account of the presence of many small accumulations of water in pools and ditches, the houses are infested with *Anopheles*: so much so that in December last I collected no less than 250 specimens within three hours in the rest-house alone. These specimens belonged to the following species :—

A. nigerrimus (the most abundant), *A. barbirostris*, *A. rossi*, *A. jamesi*, and a species which is probably new. The last may be described as follows :—

A small mosquito about the size of *A. jamesi*. *Palpi* with five nearly equal white bands ; the terminal band white, all distinct. *Proboscis* whitish, with a dark band near the middle. *Legs*—The femora and tibiæ of all the legs striped alternately with white and dark bands ; all the joints capped with white ; the remaining part of the legs, including the tarsi, dark. *Wings*—The costal vein with three large, dark bands and four small ones ; the first longitudinal vein with three large bands and two small ones ; the second with one band on the main trunk and two on the branches ; the third with three bands ; the fourth with four bands on the main trunk, three on the anterior and two on the posterior branch ; the sixth with three bands.

This species does not agree with any of the fifteen described in James and Liston's *Monograph of the Anopheles Mosquitoes of India*, being distinguished by the peculiar markings on the palpi, wings and legs. From the descriptions and figures in Theobald's *Monograph of the Culicidæ of the World*, so far as I can make them out, it seems very much like *A. punctulatus*, Dönitz, from the Malay Peninsula, but I cannot be sure of the identity.

G. C. CHATTERJEE.

ANOPHELES LARVÆ IN BRACKISH WATER.—James and Liston do not mention the occurrence of *Anopheles* larvæ in salt water in India, and recently several observers have suggested as a means of destruction of these larvæ that sea water might be admitted into pools containing them. But Mosquito larvæ have been found, though rarely, inhabiting salt water ; for example, Theobald (*Mon. Cul.*, i, p. 36) mentions that Dr. Bancroft found larvæ of *Culex marinus* in salt-water marshes in Australia. The brackish tanks at Port Canning, which also contain marine animals such as Medusæ and sea anemones, are full of *Anopheles* larvæ, which are found amongst filamentous algæ. On examination specimens proved, without exception, to be larvæ of *Anopheles rossi*. They were very abundant at the beginning of December, the water then containing 0·22 per cent. of soluble matter, but were much less so at the end of the same month. I noticed that when these larvæ were transferred to fresh water, they at once sank and crawled about the bottom of the vessel for some time. Then, by a series of muscular movements, they came to the surface. There was always a tendency for them to sink again ; whereas individuals from fresh water rise to the surface by their own buoyancy, not by muscular action, and do not remain at the bottom long if they sink. I obtained some larvæ from fresh water and placed them in water from the Port Canning pools: they died within a few hours.

G. C. CHATTERJEE.

MOSQUITOES FROM KUMAON.—Mosquitoes are very abundant in the lower parts of Kumaon at the end of September; during a visit to Bhim Tal (4,500 ft.) at that time of year the following species were collected: *Anopheles lindesayi* (Giles), *Toxorhynchites immisericors* (Walker), and *Stegomyia scutellaris* (Walker). (The last = *Culex albopictus*, Skuse.) All these were abundant, especially the first and the last. The *Anopheles* and the *Stegomyia* were breeding in water-butts by the side of European houses, and the latter also in cavities in jungle trees which had become full of rain-water.

N. ANNANDALE.

OLIGOCHÆTE WORMS.

PECULIAR HABIT OF AN EARTHWORM.—In the jungle at Bhim Tal I was surprised to find that hollows in trees which had become filled with dead leaves and rain-water, contained enormous numbers of small earthworms, all belonging to the same species. Dr. W. Michælsen, of Hamburg, has kindly examined specimens and says that they belong to the genus *Perionyx* and probably to the widely distributed species *P. excavatus*. All the specimens sent him proved to be immature, and although I made a careful search for individuals with the clitellum developed, I could not find any. The specific identification, therefore, is a little uncertain. The worms lay at the edge of the cavities, with the posterior half of the body sunk in the water and the anterior half closely applied to the wood; when touched they retreated among the dead leaves below the water. They occurred in large masses, which, owing to their bright coral-red colour and apparently filamentous structure, I mistook at first sight for fungi. I noticed that on a wet day the worms left the cavities and crawled about on the tree-trunks. Apparently they did so also at night, for I found many of them on the trunks early in the morning, while others were observed at this time of day crawling across paths and even roads. Those which were caught by the sun in such positions were killed, and almost every morning dead individuals, which apparently had perished because they had not reached a damp situation early enough, could be found on the exposed road surrounding the lake. I have noticed in the Malay Peninsula that certain species of Scorpion are subject to the same danger.

Together with the worm, I took in the tree-hollows numerous larvæ of the Mosquito *Stegomyia scutellaris* and of a beetle (probably an Elaterid), while I observed a handsome Tipulid, which Mr. E. Brunetti has identified as *Pselliophora chrysophila* (Walker), laying its eggs on the wood at the edge.

N. ANNANDALE.