

XXIX. INDIAN CYPRINOID FISHES BELONGING TO THE GENUS *GARRA*, WITH NOTES ON RELATED SPECIES FROM OTHER COUNTRIES.

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(Plates XXIV—XXVI).

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INTRODUCTION.

Among the Indian fresh-water fishes few have greater interest in the study of evolution than those belonging to the genus *Garra*. Great confusion has prevailed in the taxonomy of this genus, partly because many of the species exhibit considerable individual variability, and partly because ichthyologists have attempted to apply to them specific standards unsuitable for forms apparently still in the process of adaptation to their environment. Scale-counts, number of fin-rays and proportions are all important diagnostic characters in most Cyprinid genera; but in *Garra*, at any rate, they have much less significance than the structure of certain organs and appliances modified or produced in correlation with the peculiar mode of life adopted, apparently not very long ago, by the members of the genus. Before expressing an opinion as to how this has come about it is necessary that the genus should be investigated as completely as possible on anatomical and taxonomic lines. This Annandale attempted to do, so far as the taxonomy of the Indian species is concerned, in two recent papers (1919*a, b*), while Narayan Rao (1920) has still more recently published a third paper on the same subject and Annandale and I have discussed the generic position of the fish in a fourth (1920).

The great difficulty under which we have laboured hitherto has been that the type-specimens of older species were not available and that the figures and descriptions previously published were inadequate. This difficulty has now been overcome to a great extent, firstly because the old collection of the Indian Museum, including types of the species described by Day, which was sent to Dr. V. Pietschmann before the beginning of war, has been returned to Calcutta, and secondly because I have been able to visit and obtain specimens from the same localities in which Hamilton Buchanan found his specimens of *Cyprinus* (*Garra*) *lamta*, the genotype of *Garra*. The collection of the Zoological Survey of India has also been very largely augmented by the addition of specimens from many parts of the Indian Empire, and we have in particular received from Mr. Narayan Rao and Mr. G. E. Shaw, to whom our best thanks are due, valuable series from Coorg and the Darjiling Himalayas respectively. The Bombay Natural History Society has also lent us some interesting forms, and practically all the Indian districts whence specimens of the genus have been described are now well represented in our collection.

My sincere thanks are due to Dr. N. Annandale for placing the valuable material in my hands for investigation and description and for allowing me to visit some hill-streams to study these fishes in nature. I am indebted to Dr. S. W. Kemp for going through the manuscript with me and also for some valuable suggestions. I have also to express my obligations to Mr. Tate Regan for the courtesy he has shown me in sending at my request a copy of Heckel's original description of the genus *Discognathus*.

HISTORY

Hamilton Buchanan, in his classical work entitled "*An account of the Fishes of the Ganges*," published in 1822, was the first to describe a species—*Cyprinus lamta*—with a disc behind the lower jaw, which he "found in rivulets, with rocky bottoms, in the province of Behar, and in the Rapti River of the Gorakhpur District." This characteristic form he referred to his ninth division of *Cyprinus* which he termed *Garra*. A decade after this Gray (1832) figured a similar species, *Cyprinus gotyla*, also with a disc on the lower jaw, from "Mountain Stream, India"; while McClelland (1838, 1839, 1842) recorded a number of species with the same character from streams in the Eastern Himalayas. The latter, however, described his specimens under two genera, *Gonorrhynchus* and *Platycara*, and seems to have attached no importance to the character of the disc. Sykes (1841) also paid little attention to this well-marked structure in *Chondrostoma mullya* from South India and it was left to Heckel to recognise its value as a generic distinction when he referred his Syrian specimens (1843) to the new genus *Discognathus*. Heckel refers to Gray's species and also to those described by McClelland, but seems to have been unaware of the existence of *Cyprinus lamta* and *Chondrostoma*

mullya. In 1844 he described *Discognathus fusiformis* from Bombay and two years later he recorded similar forms from Abyssinia. Jerdon (1849) recorded *Gonorhynchus gotyla* and described two new species in the same genus from South India; while Blyth (1860) adopted *Platycara* of McClelland in describing a new species from Burma. Bleeker (1863a) recognised Buchanan's *Garra* as a distinct genus and gave the name of *Garra ceylonensis* to a new species from Ceylon. In the *Atlas Ichthyologique*, III, p. 24, 1863, Bleeker described two subgenera of *Garra*, Ham. Buch., *Garra* and *Discognathus*, distinguishing them merely by the number of barbels, which are four in the former and two in the latter. Day (1865, 1867) in a series of papers on the Fishes of South India gave an account of some new species of *Garra*, and in 1869 erected a new genus *Mayoa* for two specimens he found in the Calcutta Museum which probably came from Northern India. After the publication of Günther's catalogue (1868) Day, when writing a "Monograph of Indian Cyprinidae" (1871), evidently recognised only one Indian species of *Discognathus*, for he places all the then known species, with the exception of *D. variabilis*, under the synonymy of *D. lamta*; at the same time he allowed his new genus, *Mayoa*, to stand with a single species, *M. modesta*. Next year he recorded a peculiar specimen from the Salt Range, Punjab, which he referred to *D. lamta*. In his later works Day (1878, 1889) abolished his new genus and recognised three species, viz. *D. lamta*, *D. jerdoni* and *D. modestus*. Steindachner (1867) recorded *Garra gotyla* from Simla and added a few notes on the characters of *G. lamta*. Günther (1868) recognised *Discognathus variabilis* and *D. nasutus* and described *D. macrochir* as a new species; all the remaining known forms he regarded as synonymous with *D. lamta*. In 1889 he also referred specimens collected in Afghanistan to *D. lamta*, while Playfair (1870) and Blanford (1870) gave on his authority the same name to their Arabian and Abyssinian specimens. Sauvage (1874) obtained a new species, *D. prochilus*, in China, while Lortet (1883) and Tristram (1884) referred their Palestine examples to *D. lamta*, the latter author pointing out, however, that they might represent the species—*D. rufus*—which Günther had considered to be a synonym of the former. Vinciguerra (1883) recorded *D. lamta* from Africa and described a new species, *D. chiarinii*, from the same continent. Later on, in 1889, while writing an account of the fishes of Burma, he named another new species *D. imberbis* and recorded *D. lamta*. Nikolsky (1897, 1899) recorded *D. variabilis* and *D. lamta* from Persia and its vicinity, but later on (1900) described the specimens which he had previously referred to *D. variabilis* as a new species, *D. rossicus*, while those referred to *D. lamta* were made the type of another new species, *Garra persica*, by Berg (1913). Boulenger in a series of papers (1901, 1903, 1905) and in his two works (1907, 1909) on the fishes of Africa stimulated research in this genus and himself described and figured as many as seven species of *Discognathus*, while quite recently another species has

been described from the same continent by Nichols and Griscom (1917). Vaillant (1902) described a new species, *D. borneensis*, from Borneo; this was referred to the genus *Garra* by Fowler (1905) and again placed in the genus *Discognathus* by Weber and Beaufort (1916). Pellegrin in 1905 gave the name of *D. rothschildi* to a species from Abyssinia; this Boulenger in 1909 regarded as doubtfully synonymous with *D. dembeensis*. Regan in 1909 and 1914 described two new species, one from Yunnan and the other from Waziristan respectively. Jenkins (1909), after having examined the specimens in the Indian Museum, preferred to call all of them *D. lamta* and in 1910 he also referred a fish from Baluchistan to the same species. In 1912 Garman described a new species, *G. imberba*, from Western Szechuan, China. He referred it to a new subgenus of *Garra*, which he termed *Ageneiogarra*. This subgenus he distinguished from the two others recognised by Bleeker (1863) by the absence of barbels. Zugmayer (1913) hesitatingly referred his examples from Pishin in Baluchistan to two species, *D. lamta* and *D. variabilis*; while Chaudhuri in the same year recorded *D. lamta* from the Abor Hills. Annandale (1913), when writing notes on the fishes of the Lake of Tiberias, recognised at least four races of *D. lamta* and in Chaudhuri's paper he pointed out that the Abor examples might represent the Assamese race *nasutus* of McClelland; in two more recent papers (1919) he recognised many Indian forms to be specifically distinct. Jordan and Evermann (1917), when urging the revival of old names, pointed out that *Garra* is a valid genus, and Rao (1920) has quite recently described certain fishes from Mysore under this generic name. Still more recently Annandale and myself (1920) discussed the advisability of recognising both *Garra* and *Discognathus* on certain anatomical grounds. Prashad (1919) described a new species from the Kangra Valley, Punjab, and in 1920 I outlined the evolution of *Garra* from the allied Cyprinid genera.

The chequered history of the genus *Garra*, characterised by the presence of a mental disc behind the lower jaw, has resulted from various causes. The greatest confusion has, however, centred round *Garra lamta* of which a short and inadequate description without a figure was given in *An account of the Fishes of the Ganges* by Hamilton Buchanan. An illustration of a species with the disc-character well marked occurs among the manuscript drawings of this author, now preserved in the library of the Asiatic Society of Bengal; it is labelled *Cyprinus godyari*. Both *godyari* and *lamta* are local names of the same fish in the Bhagalpur and Gorakhpur districts respectively, and it is clear from a remark on page 103 of Day's volume on the fisheries and botany of Bengal (in Hunter's *Statistical Account of Bengal*, 1877) that the two names refer to the same species. Day, who is quoting from a manuscript of Hamilton Buchanan, says, "The Godiyari of the Bhagalpur list is here called lamta."

There has also been some confusion as to the exact localities

whence Buchanan obtained his specimens of *godyari* and *lamta*. On page 81 of the volume cited above the habitat of the *godyari*, cited under the name *sahari*, is given as, "small streams among rocks south of Monghir"; the *lamta* has been stated to occur "in the Rapti River of the Gorakhpur District." Nowadays Monghyr is not included in the Bhagalpur District but is in a district of its own; the hills towards its south, to which Buchanan referred, are the well-known Kharagpur Hills. While gathering information for a tour in these hills my attention was drawn to a significant passage in the *District Gazetteer of Monghyr* (1909) where the author, dealing with the fishes of the Man River, observes that, "The pools below the waterfalls along the latter river are tenanted by a little fish which the woodmen declare to be the young *tengra*. When flood comes this little fish finds it very difficult to hold its own against the stream; but nature has provided it with a sucker, which enables it to fasten itself to the rocks and wait securely until the flood has passed." This passage proved of great assistance in determining the habitat of *Garra lamta* recorded by Hamilton Buchanan from the then known Bhagalpur District and in October 1920 a series of specimens was obtained in the Man River. The fish were fairly abundant in small pools below the *Katin* waterfall, but it was very difficult to net them as on the slightest provocation they would hide themselves underneath stones. By bailing the water from an isolated pool in the course of the *Katin nallah* eight specimens were obtained, one was found in the Bhaura Stream, a tributary of the Man River, and another near the *Uttar band*, the canal outlet on the eastern side. From the passage quoted from the *Gazetteer*, it would be inferred that the local name of *Garra lamta* is "*tengra*" in these parts. I have not been able to verify this, but found two local names instead current among the fishermen, *Gudar*¹ and *Patharchat*; in the former reference is made to the rounded subcylindrical form of the fish and in the latter to its habit of adhering to stones. The fish was said to be very common during the rains and it is stated that at this season a large number climb up the artificial waterfall known as *Katin*. After having made collections at Kharagpur, I went to Gorakhpur to see the fishes of the Rapti River, but failed to find a single specimen of *Garra*. Moreover the name *lamta* was strange in the town of Gorakhpur and its vicinity. Even enquiries from old fishermen elicited no information as to the occurrence of a fish with this name in the district, nor did they recognise as local fish some specimens of *Garra* which I had brought with me. It may here be remarked that the Rapti River near Gorakhpur is a muddy channel and its bed is nowhere rocky within a few miles of the town.

In giving a synopsis of the species of a genus of fish a good

¹ *Gudar* is also the vernacular name given to all species of *Nemachilus* in the Kumaon Hills.

deal of importance is generally attached to the number of fin-rays and scales, but in *Garra* these characters are variable and it is impossible to use them in separating one species from another. Jenkins (1909) relied on these very characters and came to the conclusion that, "there are no specimens of *Discognathus* in the Indian Museum which justify me in considering that there is more than one Indian species of this genus." In both the Indian and African species the general rule is that there are seven to eight branched and two to three unbranched rays in the dorsal, while in the anal there are five branched besides one or two that are unbranched. The number of scales along the lateral line varies from 33 to 44. Marked deviations from these numbers occur only as abnormalities and minor differences are always bridged over when a large series of specimens are examined from the same locality.

In the absence of any well-marked characters, in the number of scales and fin-rays, Günther (1868) attributed to *G. lamta* a very wide range extending from "Syria to Assam," and ever since this statement was made, authors in general have attributed any species of this genus from any part of this region to *G. lamta*. In particular Day, who had previously recognised several species from South India, subsequently (1871) referred them all to *G. lamta*, but later on (1878) insisted on the specific validity of *G. jerdoni*.

No less confusion has been caused by a black spot that is present in many species behind the angle of the operculum. Also there is often a series of black spots at the base of the fin-rays of the dorsal fin.

In certain species of *Garra* a proboscis is present on the snout and this has been regarded as a secondary sexual character restricted to males, in *G. stenorhynchus* and *G. bicornuta*, however, the proboscis is known to be common to both sexes. Very little is known about the variation of the proboscis or the conditions which influence its formation. I have found after examination and dissection of a large series of specimens from all parts of India that wherever a well-developed proboscis is present it is always common to both sexes except in the classical species *G. lamta*, in which a peculiar proboscis is present in the male sex only.

The credit of stimulating research in this genus belongs to Boulenger, who recognised many species of *Garra* from Oriental Africa and pointed out in 1907 that the Asiatic species of the genus were much in need of revision. Annandale (1913, 1919) attempted to revise the Indian species in a series of valuable papers, but unfortunately the old collection of the Indian Museum containing Day's types was at that time interned in Austria, having been sent to Dr. V. Pietschmann before the outbreak of war.

PROBABLE EVOLUTION OF THE DISC IN *GARRA*, AS
REPRESENTED BY A SERIES OF SPECIMENS
COLLECTED IN MANIPUR, ASSAM.

The young specimens on which the following observations were made, were collected in various hill-streams that flow into the Manipur Valley from the surrounding Naga Hills. I have figured eight stages in the text, seven of which are drawn from the Manipur specimens while stage 2 is a copy of the illustration previously published by Annandale and myself (1920). The original of the figure was then referred to *Garra nasutus*, but I am unable to assign it to any species now on account of the immaturity of the specimen, which is only 7.4 mm. in length. The Manipur examples are, however, much larger and I have been able to identify them as *Garra rupeculus*. This is one of the smallest known species of the genus and is extremely well-adapted for life in rapid running streams. The following are the localities and measurements of these examples :—

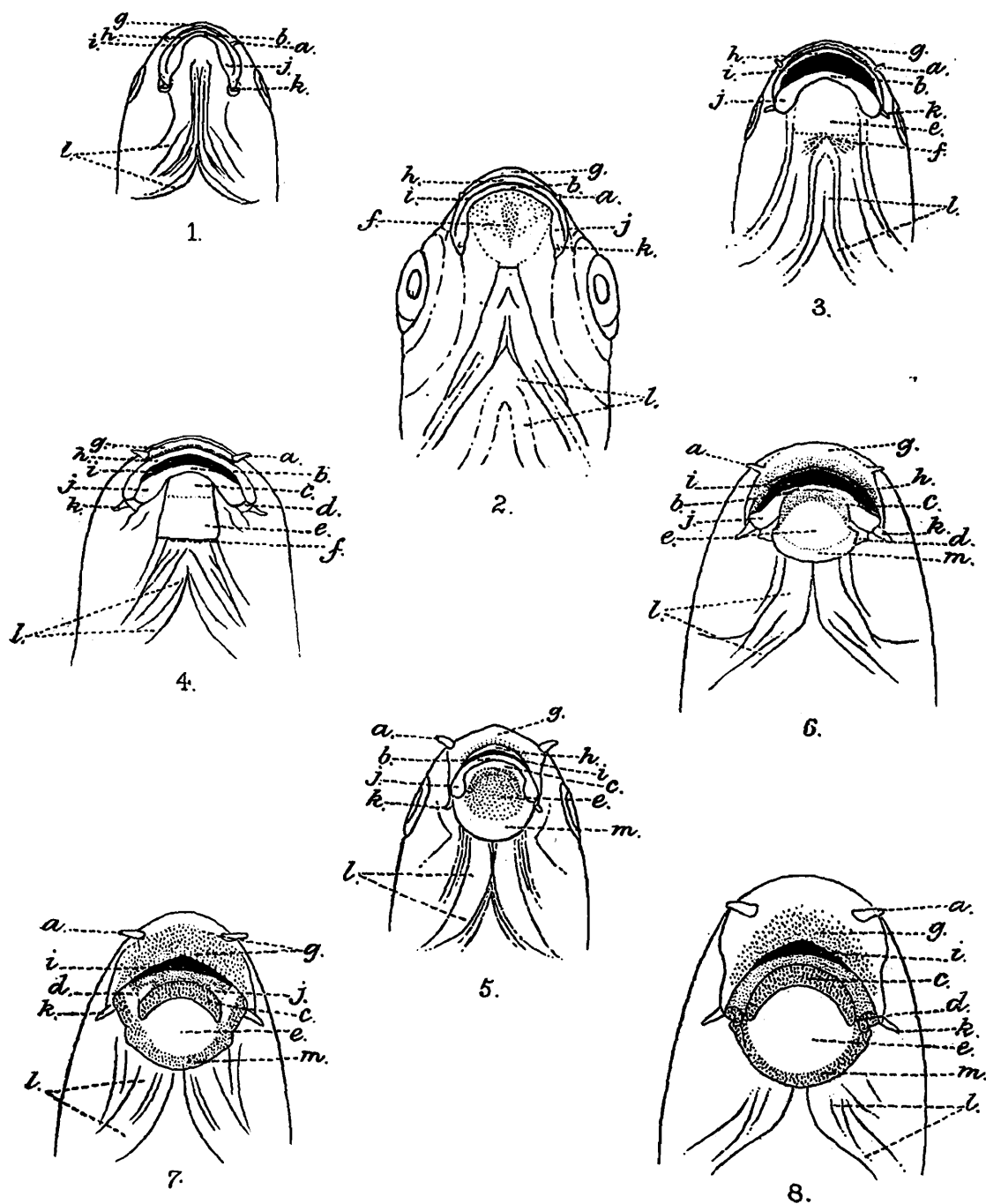
Stage No.	Locality.	Length without caudal.
		mm.
1	Small stream, 3 miles N.W. of Potsengbaum	13.4
3	Small stream near Kangpokpi ...	18.5
4	Thaubal stream near Yaribuk ...	20.0
5	Sikmai stream near Palel ...	18.5
6	Thaubal stream near Yaribuk ...	21.0
7	" " " " ...	19.0
8	" " " " ...	25.0

It is unfortunate that very little attention was paid to the preservation of these specimens in the field; I was not aware at the time that these young examples would yield such interesting results. The region of the head, however, is well preserved in all the specimens, but the opening of the mouth, which in some examples gapes widely, while in others it is completely closed, considerably alters the ventral aspect, especially the extent of the labial folds and the lips. It is clear from the measurements given above that the stages in the development of the disc are not necessarily correlated with size, but that they may depend upon the age of the fish. We are as yet ignorant of the stimuli that hasten or retard the development of this interesting organ in a particular environment.

The figures are semi-diagrammatic and are drawn with the help of a camera lucida.

Great difficulty has been experienced in the terminology of the disc and its associated structures. The mouth in this genus is situated on the under surface and hence the so-called upper and lower lips are really anterior and posterior in relation to the mouth. Moreover the true lips are only visible either in the less advanced species or in the younger stages of the more advanced forms; with

the growth of the fish they are in the latter case covered by secondary folds. These, the anterior and the posterior labial folds, have hitherto been termed the upper and the lower lips.



TEXT-FIG. 1.—Development of mental disc in *Garra*.

1—8 represent successive developmental stages of the disc in *Garra*.

a = rostral barbel; *b* = median portion of posterior lip; *c* = posterior labial fold; *d* = connective; *e* = callous portion of disc; *f* = papillate disc rudiment; *g* = anterior labial fold; *h* = anterior lip; *i* = mouth; *j* = lateral swollen portions of posterior lip; *k* = maxillary barbels; *l* = branchiostegal rays; *m* = posterior free margin of disc.

Although the development is gradual I have thought it convenient to select a number of representative stages and to describe each in detail.

In stage 1 the mouth is situated slightly behind the tip of the snout and is bordered by the true lips. In front of the ante-

rior lip (*h*) is a narrow groove which separates it from the fold (*g*) covering the tip of the snout. Both the lips are continuous near the angle of the mouth. The anterior lip is of almost uniform thickness throughout and is partially covered by a flap of the posterior lip (*j*) near the angle of the mouth. The posterior lip can be divided for description into three parts, the median narrow part (*b*) and the two swollen bulb-like lateral portions (*j*). The bony elements of the jaws are not visible. There are two pairs of short barbels and the eyes are distinctly visible from below. There is as yet no indication of the disc and the branchiostegal membranes which meet at an acute angle are continued forwards for a considerable distance.

A slightly more advanced stage is shown in figure 2, the only noteworthy feature being the presence of an almost circular area (represented by dotting in fig. 2) immediately behind the posterior lip. This area I consider to be the rudiment of the disc organ.

In stage 3 the disc rudiment (*f*) is restricted and is represented by a few papillate concentric lines, the squarish area between these and the posterior lip may now be called the disc proper (*e*). At this stage the branchiostegal membranes are slightly separated and the branchial isthmus has become wide.

A marked change is shown in stage 4. The disc rudiment is now represented by a transverse line of papillae (*i*) just behind the disc proper (*e*); the anterior portion of the latter is indistinctly demarcated as a somewhat prominent lobe which ultimately develops into the posterior labial fold (*c*). Changes have also taken place in the lateral bulb-like portions of the posterior lip (*j*). A small area on each side is separated off just at the angle of the mouth and is represented in the figure as a connective (*d*) between the anterior and the posterior lips. The branchial isthmus is still further widened and the branchiostegal rays are slightly reduced with their membranes somewhat separated. By a careful comparison of the four stages it can readily be seen that the mouth has shifted backwards and that the anterior labial fold is coming into prominence.

Between the fourth and the fifth stage there is a lack of continuity. The disc rudiment is entirely absent and the anterior labial fold is more extensive; it has almost covered the anterior lip (*h*), of which only the median portion is visible. The mouth opening has shifted still further backwards and the disc is well marked with lunate anterior (*c*) and semicircular posterior (*m*) borders. In the development of the branchial isthmus, the branchiostegal membranes and rays and the posterior lip, the specimen from which this stage is described is less advanced than that shown in stage 4. The connectives have not yet been separated, though near the angle of the mouth the lip is greatly swollen.

In stage 6 the features of the disc and the anterior labial fold (*c*) are well pronounced, and the connective (*d*) is a distinct structure. Changes have also taken place in the posterior lip and

the branchial region. The antero-median portion of the posterior lip (*h*) has become very thin and in its place the anterior border of the disc is coming into prominence. In the branchial region the isthmus is wider, and the rays much reduced.

In stage 7 we are approaching the definitive form. The anterior lip is entirely hidden underneath the labial fold which is now distinctly fringed and tuberculate, and the median portion of the posterior lip is represented by small prominences in front of its posterior swollen region. The connective is well-marked and forms an anterior continuation of the posterior border of the disc on either side. The posterior jaw is now visible in the middle. The branchiostegal membranes no longer meet behind the disc and their rays are greatly reduced.

In the final stage all traces of the posterior lip are gone except for the connective (*d*) near the angle of the mouth; the mouth is now surrounded by secondary folds both anteriorly and posteriorly. The isthmus is much wider and the rays in the branchiostegal membranes greatly reduced. From this stage it is but a small step to reach the condition found in the adults of the most advanced species. The only change is that the isthmus is still wider and the rays further reduced.

It will be advantageous at this point to enumerate the lines along which the development of the under surface of head has taken place in *Garra*:—

(i) The anterior labial fold develops considerably and ultimately covers the anterior lip.

(ii) The anterior lip, though prominent in the younger stages, is much reduced in the older and is covered by the anterior labial fold.

(iii) The mouth, which at first occupies a position near the tip of the snout, becomes shifted backwards and in all the older stages is clearly ventral in position.

(iv) The posterior lip in younger stages is narrow in the middle, but greatly thickened near the angle of the mouth. During the development of the fish the median part is replaced by a posterior labial fold; but the thickened portions near the angles separate off and form definite connectives on either side between the upper labial fold and the posterior border of the disc.

(v) The disc begins as a finely papillate squarish area just behind the posterior lip. Its anterior portion is early marked off into the disc proper and the papillae (which are probably the disc rudiments) are pushed backwards. They ultimately vanish and their place is taken by the posterior border of the disc. The anterior border of the disc is marked off as a posterior labial fold having a callous circular portion in the middle.

(vi) The branchial membranes containing the branchiostegal rays meet for a considerable distance in young individuals, but with the growth of the fish they are widely separated and the rays in them greatly reduced.

(vii) The eyes in the adult are usually invisible from below though visible in the first few stages on the under surface.

It seems quite probable that the various changes enumerated above have been brought about by the rolling of the skin covering the snout towards the under surface and that the mouth changes its position and is being gradually shifted backwards. By this process the anterior labial fold is formed and the divergence and reduction of the branchiostegal membranes and the rays brought about. How the true lips are replaced by secondary folds is a matter of detail. The disc develops from the papillate disc rudiment.

In adults of certain less specialised species of the genus, the structure of the disc and the associated organs resembles a stage in the development of typical species of the genus. Thus *G. chaudhurii* and *G. quadrimaculatus* are similar to stage 4, while *G. vinciguerrae* shows a considerable resemblance to stage 5. In almost all the species that occur in Persia, Syria and Africa the mental disc is less specialised and the true lips are usually present. The new species from Darjiling is represented by three specimens, two of which are mature males and the other a ripe female. The mental disc in the three specimens shows progressive specialisation beginning with stage 4 of the developmental series described above. It is not uncommon to find one or two specimens in a big collection of typical *Garra* in which the branchiostegal rays meet at an acute angle behind the disc and the branchial isthmus is narrow. It is still more common to meet with examples in which the posterior and the anterior borders of the disc are poorly developed, but it is always possible, after examining a large number of individuals from the same locality, to refer them along with normal specimens to their proper species.

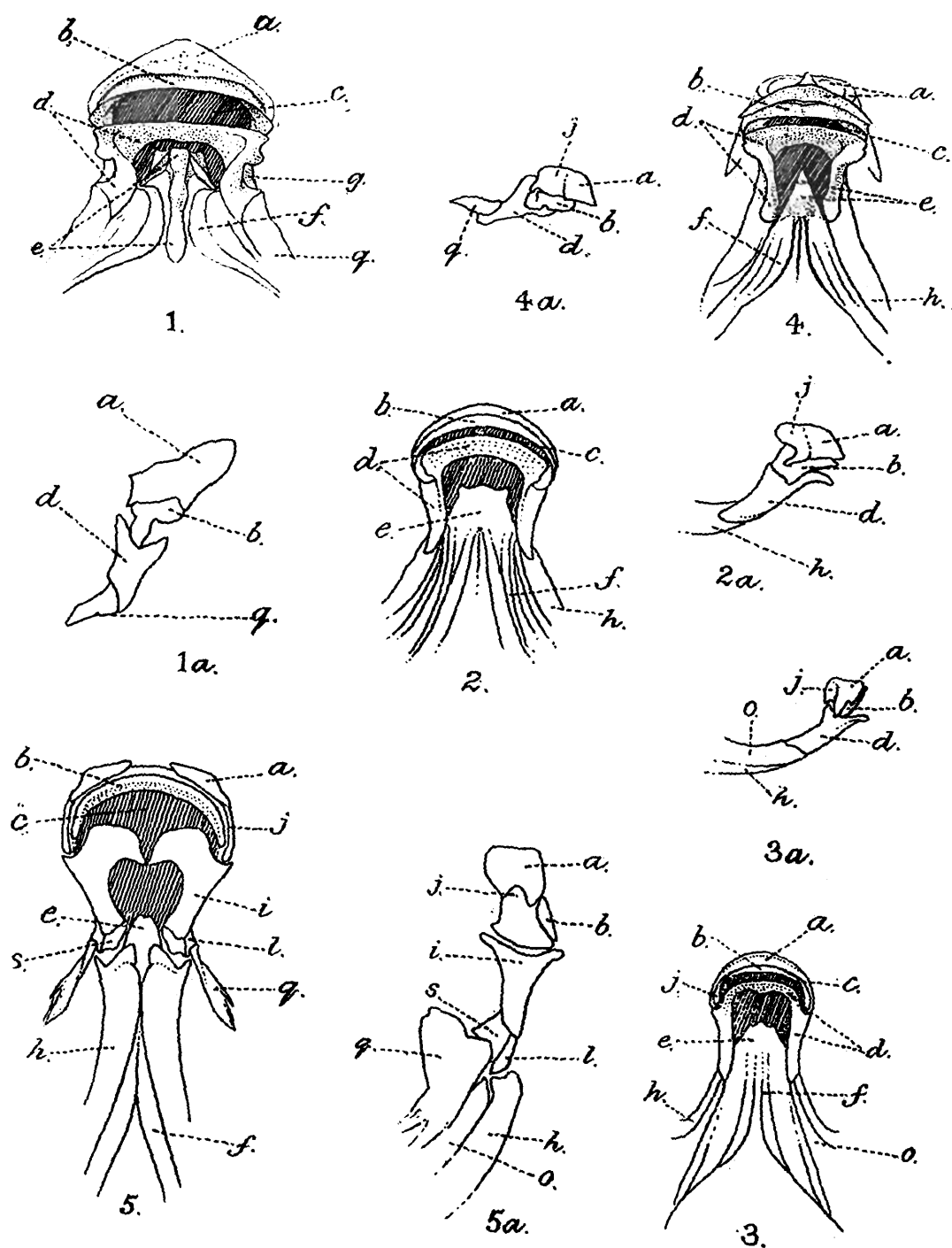
In the collection of the Zoological Survey of India there is a series of young specimens from Madras collected by Major Sewell. Of these I have been able to determine only four stages which are separated from each other by fairly wide gaps.

SKELETON OF THE MOUTH-PARTS.

Boulenger (1907), when defining the genus *Discognathus*, gave the following short account of its skeleton:—"The skeleton is very similar to that of *Labeo*, but the premaxillaries emit short ascending processes, the posterior edge of the mandible is raised into a process at the symphysis, and the clavicles do not form a diaphragm." So far as the skeleton of the mouth-parts is concerned, I find great dissimilarity between that of *Labeo* and that of *Garra*. The nearest approach to *Garra* is made by *Cirrhitina* and *Crossochilus*. The following are some of the salient points in which the mouth-parts of *Labeo* (fig. 2, 5, 5a) differ from those of the other genera enumerated above:—

(i) The bones are distinct and separate and have not coalesced to form a rigid structure.

(ii) The maxillae of the two sides are widely separated in the middle.



TEXT-FIG. 2.—Skeleton of mouth-parts of *Garra* and allied genera.

1. *Garra mullya* (Sykes), ventral view.
- 1a. Same, lateral view of upper and lower jaws.
2. *Garra rossicus* (Nikolsky), ventral view.
- 2a. Same, lateral view of upper and lower jaws.
3. *Cirrihina mrigala* (Ham. Buch.), ventral view.
- 3a. Same, lateral view of upper and lower jaws.
4. *Crossochilus latia* (Ham. Buch.), ventral view.
- 4a. Same, lateral view of upper and lower jaws.
5. *Labeo rohita* (Ham. Buch.), ventral view.
- 5a. Same, lateral view of upper and lower jaws.

a = maxilla; b = premaxilla; c = mouth cavity; d = lower jaw; e = urohyal; f = branchiostegal rays; g = portion of skull; h = preoperculum; i = dentary; j = jugal; l = splenial; o = interoperculum; q = quadrate; s = articular.

(iii) The articular and dentary bones on each side have fused to form a single piece, but those of the two sides are distinctly separate.

(iv) The preopercular bones meet or slightly overlap just behind the lower jaw, presenting an articular surface anteriorly.

(v) The branchiostegal rays are concealed under the opercular borders anteriorly and are not visible for a considerable distance behind the mouth.

(vi) The mouth points anteriorly and is considerably nearer to the dorsal than to the ventral profile of the fish.

From the points enumerated above it is clear that *Labeo* represents a skeletal structure of the mouth parts, which is at a low stage of organisation; but at the same time we must remember that in *Labeo* the mouth is suctorial and this probably accounts for the mobility of its component parts.

Now let us examine more closely the condition found in a specialised member of the genus *Garra* (fig. 2, 1, 1a). The sutures between the various bones are absent and the skeleton presents a solid structure. The mouth having been shifted backwards, the maxillae and the premaxillae are well developed and are fairly broad. The backwardly directed process of the posterior jaw (corresponding to the articular bone, etc., of other bony fishes) is short and curved instead of being straight as in *Labeo*; those of the two sides are widely separated and articulate with the quadrate of each side respectively. The basihyal is very prominent in the middle behind the lower jaw and is distinctly separate from other structures throughout its length posteriorly. Anteriorly it is flattened out laterally on the dorsal surface and to this are attached the anterior ends of the branchiostegal rays which are greatly reduced and are represented by two or three short bony elements. The rays of the two sides are widely separated in the middle. On account of the position of the mouth, both the jaws have to be accommodated in a short space.

In a less specialised form of the same genus (fig. 2, 2, 2a) the fusion of the bony elements is not complete and the position of the mouth near the tip of the snout considerably alters the whole arrangement. The jugal is visible as a separate bone and a faint line of demarcation can be made out between the dentary and the articular bones. The articular is almost straight and meets the opercular border behind; it is visible on the ventral surface. The basihyal is seen as a rounded process behind the posterior jaw, but is covered for a greater part of its length by the branchiostegal rays, which are but slightly reduced. The rays of the two sides meet for a considerable distance on the ventral surface.

The structure met with in *Cirrhitina* (fig. 2, 3, 3a) is not very different from that described above, the only difference being that more of the opercular elements are visible on the under surface, the visible portion of the basihyal is further reduced and the branchiostegal rays and the articular bones have become more marked.

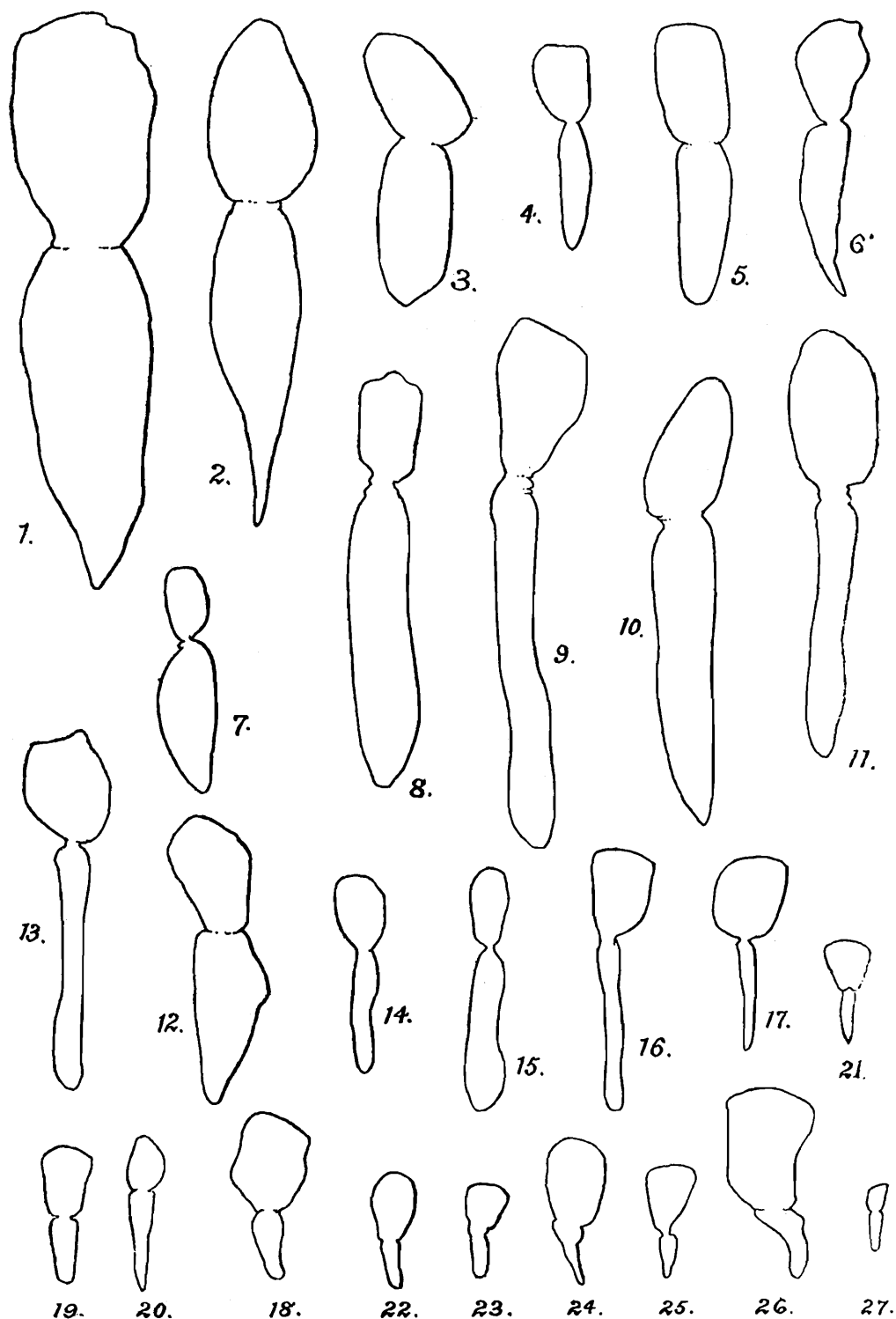
In *Crossochilus* (fig. 2, 4, 4a) the mouth is situated considerably behind the tip of the snout and consequently the structure of the mouth-parts is different from that found in *Cirrhhina*, and in certain respects resembles that of a specialised form of *Garra*. It may also be pointed out that, like *Garra*, a fringed, tuberculated, well-developed anterior labial fold is present in *Crossochilus*. The articular bone is fairly extensive and only a small portion of the basihyal is visible from below. The branchiostegal rays meet for a short distance behind the tip of the basihyal and then suddenly diverge outwards. The rays are reduced.

AIR-BLADDER AND ASSOCIATED SKELETAL STRUCTURES.

The air-bladder has long been considered to be an organ of the greatest importance in the taxonomy of the bony fishes and especially in distinguishing the families of Cyprinoidea. I have carefully examined this organ in the various species of *Garra* and also in *Labeo rohita*, *Cirrhhina mrigala* and *Crossochilus latia*. The comparison is instructive. The normal type of bladder is present in *Cirrhhina* (fig. 3, 2) and *Labeo* (fig. 3, 1) and its length is contained about 3.3 times in the length of the fish including the caudal fin. The anterior chamber is smaller than the posterior and is in the form of a short massive cylinder. The posterior chamber is almost as broad as the anterior a short distance behind its commencement, but thence it gradually tapers to the end. In all the less modified species of *Garra* that I have examined, viz. *G. adiscus*, *G. rossicus*, *G. blanfordi* and *G. rufo*, the bladder agrees with this type in form and extent, whereas in all specialised species of the genus and in *Crossochilus latia* it is somewhat modified. The modifications chiefly consist in the form and extent of the posterior chamber, which, instead of being swollen in the middle, may be of uniform thickness throughout, with its walls somewhat thickened. This condition is found in *Garra gravellyi*, *G. jenkinsoni* and *G. mullya*. In the remaining species the whole of the bladder is greatly reduced and its length is never contained less than 5 times in the length of the fish. The extreme phase of reduction within the genus is reached in *Garra stenorhynchus*, *G. arabica*, *G. gotyla* and *G. nasutus*, in which the bladder is contained about 15 times in the length of the fish without the caudal. In *G. gotyla*, *G. nasutus* and *G. lissorhynchus*, the bladder is covered by a thick, fibrous coat and is firmly fixed to the body-wall. In some species the posterior chamber is greatly reduced and its cavity almost obliterated.

In *Crossochilus* (fig. 3, 11) the bladder resembles that of certain species of *Garra*; its length is contained 5.3 times in the total length of the fish. The posterior chamber is long but of uniform thickness throughout.

Having found so much variation in the species of *Garra* as regards this interesting organ I was almost tempted to regard it



TEXT-FIG. 3.—Air-bladder of *Garra* and allied genera.

- | | |
|--|--|
| 1. <i>Labeo rohita</i> (Ham. Buch.). | 14. <i>Garra notata</i> (Blyth). |
| 2. <i>Cirrhitina mrigala</i> (Ham. Buch.). | 15. <i>Garra</i> sp. (from Persia). |
| 3. <i>Garra rufus</i> (Heckel). | 16. <i>Garra naganensis</i> , sp. nov. |
| 4. <i>Garra blanfordi</i> (Boulenger). | 17. <i>Garra prashadi</i> , sp. nov. |
| 5. <i>Garra rossicus</i> (Nikolsky). | 18. <i>Garra jerdoni</i> , Day. |
| 6. <i>Garra adiscus</i> (Annandale). | 19. <i>Garra kempi</i> , sp. nov. |
| 7. <i>Garra lamta</i> , Ham. Buch. | 20. <i>Garra abhoyai</i> , sp. nov. |
| 8. <i>Garra jenkinsonianum</i> , sp. nov. | 21. <i>Garra lissorhynchus</i> (McClelland). |
| 9. <i>Garra gravelyi</i> (Annandale). | 22. <i>Garra gotyla</i> (Gray). |
| 10. <i>Garra mullya</i> (Sykes). | 23. <i>Garra nasutus</i> (McClelland). |
| 11. <i>Crossochilus latia</i> (Ham. Buch.). | 24. <i>Garra stenorhynchus</i> (Jerdon). |
| 12. <i>Garra bicornuta</i> , Rao. | 25. <i>Garra arabica</i> , sp. nov. |
| 13. <i>Garra mullya</i> (Sykes), hill-stream form. | 26. <i>Garra stenorhynchus</i> (Jerdon). |
| | 27. <i>Garra rupeculus</i> (McClelland). |

as a specific character; but further examination showed that it is not only variable in the different species of the genus, but differs in individuals of the same species as well. Moreover, in the young individuals it is in all species very much like the normal form. As I have already remarked, it is not surprising to find considerable variation in an organ which shows retrogressive degeneration. I hope to deal with this aspect of the matter shortly in a separate paper dealing with the adaptations of the hill-stream fishes.

I have examined the weberian ossicles in these genera and do not find any great departure in any of them from the normal form. The platform formed by the transverse processes of the third vertebra shows certain modifications, but their discussion is beyond the scope of the present enquiry.

GARRA AND DISCOGNATHUS.

Quite recently Annandale and myself (1920) recognised *Discognathus* as a separate genus from *Garra*, basing our distinction mainly on the position of the mouth, which in the former is situated near the tip of the snout, on the presence of vestigial lips and disc in *Discognathus* and lastly on the fact that in the genus *Discognathus* the "opercular and preopercular borders" meet "at an acute angle on the ventral surface some distance behind the adhesive disc." In view of the developmental series described above and also in view of the occurrence in the Darjiling Himalayas of a form very similar to *G. quadrimaculatus* from Oriental Africa, I am unable to retain the view recently expressed by Annandale and myself. If two genera are adopted the systematic position of certain stages in the development of some advanced members of *Garra* becomes obscure and certain abnormalities due to restricted development cannot easily be referred to their proper genera.

Garman (1912) divided the species of the genus *Garra* into three groups which he considered as distinct subgenera. He based his distinction on the number of barbels and recognised Bleeker's (1863) two subgenera, *Garra* and *Discognathus*, as valid. He at the same time proposed a new subgenus, *Ageneiogarra* (to accommodate his species *G. imberba* from China), characterised by the absence of barbels. The specific name he employed for his new species is preoccupied, as Vinciguerra (1889) has described a fish from Burma as *Discognathus imberbis*. The barbels are so minute throughout the genus that I do not regard their occasional absence as a character of subgeneric importance.

As regards the relationship of *Garra* with other Cyprinid genera, it is better to postpone a full discussion until the Malay forms assigned to *Crossochilus* are available for examination. It may, however, be pointed out that great similarity exists between the mouth-parts of *Cirrhina*, *Crossochilus* and *Garra* and that *Cirrhina* holds the same relation to *Crossochilus* which the less specialised members of *Garra* hold to the more specialised forms in the genus.

SYNOPSIS OF THE INDIAN AND SOME OF THE EXTRA-INDIAN SPECIES OF *GARRA*.

In the synopsis I have included 21 Indian and 5 extra-Indian species of *Garra*. With the exception of *G. imberbis*, which can be easily recognised by the total absence of its barbels, I have examined specimens of all Indian species. I have not included *G. wanae* from Waziristan because in Regan's description of the species I could not find those characters which I have employed in building up the synoptic table.

The table does not apply to young individuals. The names of extra-Indian species are placed in square brackets.

- | | | | | |
|--|-----|-----|-----|-------------------------------------|
| a. Barbels absent | ... | ... | ... | <i>G. imberbis</i> (Vinciguerra). |
| a'. Barbels present. | | | | |
| b. Pupil of eye wholly in posterior half of head. | | | | |
| c. Proboscis present. | | | | |
| d. Proboscis trilobed. | | | | |
| e. Lateral lobes of proboscis short and in front of nostrils | ... | ... | ... | [<i>G. arabica</i> , sp. nov.] |
| e'. Lateral lobes of proboscis almost as long as central lobe, covering nostrils | ... | ... | ... | <i>G. bicornuta</i> , Rao. |
| d'. Proboscis a single projection without lateral lobes. | | | | |
| e. Proboscis well-developed with well defined lateral tubercular areas. | | | | |
| f. Snout as seen from below trenchant and bearing a well-defined almost semi-circular lobe; space between gill-openings on under surface less than post-orbital length of head. | | | | <i>G. monti-salsi</i> , sp. nov. |
| f'. Snout from below evenly rounded and convex; space between gill-openings on under surface greater than post-orbital length of head. | | | | |
| g. Eyes small, contained 5 to 6 times in length of head; distance between anus and origin of anal fin less than $\frac{1}{3}$ the distance between origins of anal and ventral fins | ... | ... | ... | <i>G. gotyla</i> (Gray). |
| g'. Eyes moderately large, contained 3.7 to 4.3 times in length of head; distance between anus and origin of anal fin greater than $\frac{1}{3}$ the distance between origins of anal and ventral fins | ... | ... | ... | <i>G. stenorhynchus</i> (Jerdon). |
| e'. Proboscis not well developed; represented by a prominent squarish area in front of nostrils; lateral tubercular areas poorly developed. | | | | |
| f. Dorsal fin considerably higher than length of head; lobes of caudal fin equal | ... | ... | ... | <i>G. gravellyi</i> ♂ (Annan-dale). |
| f'. Dorsal fin almost equal to or less high than length of head; lobes of caudal fin not equal | ... | ... | ... | <i>G. nasutus</i> (McClell.). |
| c'. Proboscis absent. | | | | |
| d. Tubercular areas on snout present | ... | ... | ... | <i>G. jerdoni</i> , Day. |
| d'. Tubercular areas on snout absent | ... | ... | ... | <i>G. annandalei</i> , Hora. |
| b'. Pupil of eye not wholly in posterior half of head. | | | | |
| c. Pupil of eye nearer posterior margin of operculum than tip of snout. | | | | |

- d.* Proboscis present on snout forming a distinct median knob; no groove marking off tip of snout ... *G. lamta*, ♂ Ham. Buch.
- d'*. Proboscis absent or represented by a raised area between the nostrils.
- e.* Tubercles on snout usually present; two short lateral grooves marking off tip of snout ... *G. mullya* (Sykes).
- e'*. Tubercles if present few; no grooves on snout (snout smooth).
- f.* Anterior origin of dorsal equidistant from tip of snout and base of caudal.
- g.* Scales present in post-pelvic region and on dorsal surface in front of dorsal ... *G. lissorhynchus* (McClell.).
- g'*. Scales absent in post-pelvic region and on dorsal surface in front of dorsal ... *G. abhoyai*, sp. nov.
- f'*. Anterior origin of dorsal not equidistant from tip of snout and base of caudal.
- g.* Ventrals distinctly reaching beyond anal opening.
- h.* Anus situated almost midway between anterior origins of anal and ventral fins ... *G. kempi*, sp. nov.
- h'*. Anus not situated midway between anterior origins of anal and ventral fins.
- j.* Distance between anus and anterior origin of anal fin greater than $\frac{1}{3}$ distance between anterior origins of anal and ventral fins ... *G. naganensis*, sp. nov.
- j'*. Distance between anus and anterior origin of anal fin less than $\frac{1}{3}$ distance between anterior origins of anal and ventral fins ... *G. prashadi*, sp. nov.
- g'*. Ventrals almost reaching or not reaching the anal opening ... *G. gravellyi*, ♀ (Annan-dale).
- c'*. Pupil of eye almost in middle of head or nearer tip of snout than posterior border of operculum.
- d.* Belly and dorsal surface in front of dorsal fin naked ... *G. rossicus* (Nikolski).
- d'*. Belly and dorsal surface in front of dorsal fin not naked.
- e.* Anterior origin of dorsal almost equidistant from tip of snout and base of caudal.
- f.* Maxillary barbels shorter than diameter of eye.
- g.* Diameter of eye contained 3.9 times in length of head ... [G. sp.]
- g'*. Diameter of eye contained 4.4 times in length of head ... *G. notata* (Blyth).
- f'*. Maxillary barbels longer than diameter of eye ... *G. chaudhurii*, sp. nov.
- e'*. Anterior origin of dorsal not equidistant from tip of snout and base of caudal.
- f.* Anterior origin of dorsal nearer tip of snout than base of caudal.
- g.* Mental disc absent or rudimentary ... [G. *adiscus* (Annan-dale).]
- g'*. Mental disc present.
- h.* Anterior origin of ventrals distinctly nearer base of caudal than tip of snout.
- j.* Anterior origin of anal nearer base of caudal than anterior origin of ventrals ... *G. lamta*, ♀ Ham. Buch.

- j'*. Anterior origin of anal nearer anterior origin of ventrals than base of caudal ... [*G. rufus* (Heckel).]
h'. Anterior origin of ventrals almost equidistant from base of caudal and tip of snout ... *G. jenkinsonianum*, sp. nov.
f'. Anterior origin of dorsal nearer base of caudal than tip of snout.
g. Ventrals extending beyond anal opening; anus considerably removed from base of anal fin ... *G. rupeculus* (McClell.).
g'. Ventrals just reaching anal opening; anus close to base of anal fin ... [*G. blanfordi* (Boulenger).]

PART I. INDIAN SPECIES OF *GARRA*

Garra bicornuta, Rao.

1920. *Garra bicornuta*, Rao, *Ann. Mag. Nat. Hist.* (9), VI, p. 57, pl. i, figs. 3, 3a, 3b.

Of this species I have examined six specimens; three are females and in the remaining three I have not been able to determine the sex.

There is a well-marked trilobed proboscis on the snout. The lateral lobes are free and tapering while the median lobe is represented by an immoveable rectangular prominence. The nostrils are situated near the bases of the former and are covered over by them.

The air-bladder is reduced, but its form is of the normal Cyprinid type. The following are the dimensions of the air-bladder in a specimen 9.7 cm. in length:—

Length of anterior chamber	...	...	6.5 mm.
" " posterior "	...	...	11.0 "
Greatest diameter of anterior chamber	...	...	4.6 "
" " " posterior "	...	...	3.6 "

In another mature female specimen 12.5 cm. in length, the air-bladder is contained almost 9 times in the total length of the fish

Tunga R., Mysore ... Narayan Rao ... 3 syntypes and 3 other specimens.

Garra monti-salsi, sp. nov.

1872. *Discognathus lamta*, Day, *Journ. As. Soc. Bengal* XLI (2), p. 318.

1878. *Discognathus lamta*, Day (in part), *Fish. India* II, p. 527, pl. cxxiii, fig. 1.

1889. *Discognathus lamta*, Day (in part), *Faun. Brit. Ind. Fish.* 1, p. 346.

In this characteristic species the dorsal profile is slightly arched, the ventral is straight and horizontal anteriorly but rises to the base of the caudal fin posteriorly. The head is much depressed and is almost rectangular; its length is contained 3.9 times in the length of the fish without the caudal; it is 1.4 times as long as broad. The eyes are situated in the posterior half of

the head and their superior margin is coterminous with the dorsal profile; the diameter is contained 5 times in the length of the head. The interorbital space is somewhat concave and is 2.2 times as broad as the diameter of the eye. The snout is thrice the diameter of the eye and bears a well-developed median proboscis, which extends almost to the anterior end of the snout. The dorsal profile of the proboscis is convex and the ventral concave; it is constricted in the middle and is tuberculated near the anterior swollen end. The snout is marked by a deep transverse cleft near its anterior end and bears two prominent tubercular areas, when seen from below the snout appears to be trenchant and shows a well-defined almost semicircular lobe near its tip. The nostrils are situated externally at the base of the proboscis a short distance in front of the eye. The posterior nostril of each side is completely covered by a rectangular lid. The slit of the mouth is arched and the mental disc is well developed. There are two pairs of barbels shorter than the diameter of the eye. The gill-openings extend for a considerable distance on the under surface and are separated from each other by a distance slightly greater than the diameter of the eye; the opercular bones are not followed by a fleshy flap posteriorly. The lateral line is almost straight and is in the middle of the body; there are 32 scales along its length and 7 longitudinal rows between the bases of the dorsal and the ventral fins. The dorsal fin is situated nearer to the tip of the snout than to the base of the caudal fin; its base is equal to the length of the head in front of the posterior margin of the orbit; the first branched ray is the longest and is much higher than the body; the free margin of the fin is concave. There are eight branched rays in the dorsal besides three that are not branched. The ventrals are situated below the middle of the dorsal and their origin is slightly nearer the base of the caudal than the end of the snout; they extend to the anus and are somewhat shorter than the pectorals which are considerably shorter than the length of the head. The anal almost extends to the base of the caudal fin.

The air-bladder is small and the scales on the chest and on the middle of abdomen are poorly developed.

The unique specimen of the species had been opened out and the viscera removed, but still I have been able to find a few minute eggs in the oviduct. It is a female 109 mm. in length without the caudal fin.

Type-specimen.—F 9953/1, *Zoological Survey of India (Ind. Mus.)*.

Locality.—The specimen was purchased from Day and is the original of the figure referred to above. It was collected for him "by Dr. Waagen from the Nilwan ravine near the Shapur salt ranges," Punjab.

Since the above description was written, I have found several specimens of the species in the unnamed collection of the Indian Museum from the Khewrah gorge (alt. 2000 ft.) in the Jhelum

District, Punjab. The adults agree with the type-specimen very closely. In the young individuals the proboscis is short and the snout when seen from below is not trenchant but is evenly rounded; the first few rays of the dorsal fin are greatly elongated and the gill-openings are somewhat wider.

Garra gotyla (Gray).

1832. *Cyprinus gotyla*, Gray, *Ill. Ind. Zool.*, pl. 88, figs. 3, 3a.
 1867. *Garra gotyla*, Steindachner, *Sitz. Ak. Wiss. Wien* LVI (1), p. 360, pl. 2, figs.
 1919. *Discognathus kangrae*, Prashad, *Rec. Ind. Mus.* XVI, pp. 163—165, figs. 1 and 1a.
 1919. *Discognathus jerdoni* var. *kangrae*, Annandale, *Rec. Ind. Mus.* XVIII, p. 74.

It is after long hesitation and not without reserve that I recognise this species as valid. Gray has not given any description of his species, but as most of his figures are made from specimens collected in Northern India, I have referred the North Indian specimens with a well-developed proboscis to this form. The specimens from the Eastern Himalayas differ, as regards the shape and proportions of the head, from those found in the Western Himalayas. The eyes in both sets of specimens, are, however, in the posterior half of the head and are comparatively smaller than in allied species of the genus.

The air-bladder in a specimen from Kangra, Punjab, is minute; its anterior chamber possesses a thick fibrous coat which firmly attaches it to the dorsal body-wall. The walls of the posterior chamber are somewhat thickened. The following are the measurements of the bladder in a specimen 14 cm. in length :—

Length of anterior chamber	...	...	4.5 mm.
" " posterior "	...	...	3.5 mm.
Greatest diameter of anterior chamber	...	...	3.0 mm.
" " " posterior "	...	...	1.5 mm.

Garra gotyla has a fairly extensive but restricted range as it occurs along the base of the Himalayas throughout their length.

Jaugal Khad, Kangra, Panjab	...	N. Annandale	...	4.
Kangra Valley, hill-streams	...	Punjab Fisheries	...	12.
Ravi R., near Madhopur, Punjab	...	" "	...	Several young.
Simla	...	Purchased from Day	...	1.
Chumba	...	" "	...	1.
Dhikla, Gharwal Dist., U.P.	...	R. Hodgart	...	1.
Mahanadi R., Darjiling Dist.	...	G. E. Shaw	...	Several.

Garra stenorhynchus (Jerdon).

1849. *Gonorhynchus stenorhynchus*, Jerdon, *Madras Fourn. Lit. Sci.* XV, p. 310.
 1849. *Gonorhynchus gotyla*, Jerdon (*nec* Gray), *ibid.*, p. 309.
 1867. *Garra gotyla*, Day (*nec* Gray), *Proc. Zool. Soc. London*, p. 288.
 1919. *Discognathus jerdoni*, Annandale (*nec* Day) in part, *Rec. Ind. Mus.* XVI, p. 132.
 1919. *Discognathus jerdoni*, Annandale (*nec* Day) in part, *Rec. Ind. Mus.* XVIII, p. 73, pl. ix, fig. 1 and pl. xi, fig. 3.

1919. *Discognathus stenorhynchus*, *id.*, *ibid.*, p. 74, pl. ix, fig. 3; pl. xi, fig. 4.
 1919. *Discognathus gotyla*, *id.*, *ibid.*, p. 75, pl. x, fig. i; pl. xi, fig. 6.
 1920. *Garra jerdonia*, Rao (*nec* Gray) in part, *Ann. Mag. Nat. Hist.* (9) VI, p. 53.
 1920. *Garra stenorhynchus*, *id.*, *ibid.*, p. 53.

The proboscis on the snout exhibits considerable variation and it is on this account that so many different species have been recorded or described from South India. Having examined numerous specimens of this form, I am convinced that all these should be referred to *G. stenorhynchus*. The extent of the snout does not depend upon the age or the sexual maturity of the specimen as is shown by the collection before me. The specimens with a comparatively small proboscis have been referred to *B. jerdoni* (*nec* Day) both by Annandale and Rao; but on dissection some of them have been found to be full of eggs.

The air-bladder is rather characteristic and provides a good specific distinction. In a ripe female specimen 12 cm. in length, the following are the measurements of the bladder:—

Length of anterior chamber	..	...	...	5.0 mm.
" " posterior "	..	...	...	3.5 mm.
Greatest diameter of anterior chamber	..	...	...	3.8 mm.
" " " posterior "	..	...	...	2.0 mm.

The bladder is provided with a thicker coat; its posterior chamber is swollen anteriorly and drawn out into a fine process posteriorly, the walls of which are thickened.

Nierolay Stream, Bhavani R., Base of Nilgiris.	N. Annandale	...	...	11.
Hill-streams, Coorg, Mysore ...	C. R. Narayan Rao	...	...	18.
Mettupalaiyam, Dist. Coimbatore.	N. Annandale	...	...	7.
Nilgiris, Madras	F. Day	...	...	2.
Madras	...	...	...	1.
?	A.S.B.	...	...	1.

***Garra gravelyi* (Annandale).**

1918. *Discognathus lamta*, Annandale; *Rec. Ind. Mus.* XIV, p. 45.
 1919. *Discognathus gravelyi*, Annandale, *ibid.*, XVI, p. 133, pl. ii, figs. 3, 3a.

Of the five specimens procured by Dr. N. Annandale from the Inlé Lake and the He-Ho stream, two are ripe females, one ripe male and two immature males. The type specimen of *G. gravelyi* is the mature male and differs considerably from the female specimens, but the presence of two young males serves to a certain extent as a connective link between the two forms. In the male the mental disc is better developed, the mouth is considerably behind the tip of the snout and consequently the labial fold is more extensive, the pectoral fins are longer than the head, the snout possesses an indistinct proboscis and the head and body are somewhat depressed with the chest almost naked, while the female lacks all these characters.

The air-bladder is quite normal and is not much reduced. In a specimen 9.7 cm. in length, the following are the measurements of the bladder:—

Length of anterior chamber	...	...	...	11 mm.
" " posterior "	...	...	...	22 mm.

Specimens of this species were examined from the following localities:—

He-Ho stream, S. Shan States	...	N. Annandale	...	3.
Fort Stedman, Inlé Lake, S. Shan States.	...	"	...	2.

Garra nasutus (McClelland).

Plate XXIV, fig. 4.

1838. *Platy cara nasuta*, McClelland, *Journ. As. Soc. Bengal* VII (2), p. 947, pl. lv, figs. 2, 2a and 2b.
 1839. *Platy cara nasuta*, McClelland, *Asiatic Res.* XIX, p. 300, pl. lxvii, figs. 2.
 1839. *Gonorhynchus caudatus*, McClelland, *ibid.*, p. 375.
 1868. *Discognathus nasutus*, Günther, *Cat. Brit. Mus. Fish.* VII, p. 70.
 1913. *Discognathus lamta*, Chaudhuri, *Rec. Ind. Mus.* VIII, p. 247.

This species is known to me from one adult specimen from the Abor Hills and from numerous young and half-grown specimens from Manipur, Assam and Manjhitar, Sikkim. As McClelland's description of the species is brief and his figures totally inaccurate, I take this opportunity to redescribe the species from the adult specimen with notes from the young examples.

D. 2/8—9. A. 2/5. P. 14. V. 8.

In *Garra nasutus* the head and body are greatly depressed and the fish comes to resemble the species of the Homalopterid genus *Balitora* in form. The dorsal profile is slightly arched; the ventral is straight and horizontal throughout. The head is almost as broad as long; the length is contained 5.7 times in the total length of the fish. The length of the caudal fin is contained 5.4 times and the depth of the body near the origin of the dorsal fin 6.2 times in the length of the fish. The eyes are dorso-lateral in position and are invisible from below; they are situated in the second half of the head and their diameter is contained 4.2 times in the length of the head, 2.6 times in the length of the snout and twice in the interorbital distance. There is a short, broad and indistinct proboscis on the snout, the tip of the snout is marked off into a rounded lobe. There are two pairs of short barbels, shorter than the diameter of the eye. The mental disc is almost circular and coextensive with the width of the head. The lateral line is straight; it is somewhat nearer to the ventral than to the dorsal surface. The scales are rather thin and almost indistinguishable; there are 34 scales along the lateral line and 8 longitudinal series of scales between the bases of the dorsal and the ventral fins. The dorsal fin is higher than the body and is almost as long as the head; its origin is nearer to the tip of the snout

than to the base of caudal fin. There are nine branched and two unbranched rays in it and the first branched ray is the longest. The ventrals originate before the fourth branched dorsal ray and extend to beyond the anal opening. The caudal fin is deeply emarginate, the lower lobe is much the longer. The colour of the body and head in spirit is uniformly dark brown with the exception of the ventral surface which is dirty-white. The colour of the upper and the lower surfaces of the paired fins corresponds to the colour of the dorsal and the ventral surfaces of the body respectively. There are black spots at the bases of the dorsal fin rays and the membrane between the rays is also blackened.

Extreme modification of the air-bladder occurs in this species. Both the chambers are minute and possess thick walls. There is a thick fibrous coat covering the bladder and fixing it firmly to the body-wall. The following are the measurements of the bladder in the adult specimen:—

Length of anterior chamber	...	...	2.5 mm.
" " posterior "	...	...	3.5 mm.
Greatest diameter of anterior chamber	...	...	2.5 mm.
" " " posterior "	...	...	1.5 mm.

In the young specimens, the head and body is not greatly depressed and the air-bladder is comparatively larger. The two lobes of the caudal fin are unequal and an indistinct proboscis is present on the snout. The head is fairly long and bluntly pointed, and the eye in some examples is not wholly in the posterior half of the head. The upper surface is dark and the under surface of the head and belly is white. The fins are white and at the base of the dorsal fin there are small black spots; sometimes a big black blotch is present before the base of the caudal fin. In an example from Manipur one of the rostral barbels is furcate.

Annandale (see Chaudhuri, 1913) identified the Abor specimen from Siyom River as *Discognathus lamta* subsp. *nasutus* (McClelland).

Distribution.—McClelland recorded it from the Khasi and the Mishmi Hill tracts. Specimens of this species have now been obtained in the Abor Hills and in the Manipur Valley, Assam. I refer numerous young specimens from Sikkim to this species with some doubt.

Siyom R., below Damda, Abor Hills.	S. W. Kemp	...	...	1.
Assam	...	Purchased from Day	...	?
Manjhitar, Sikkim	...	B. L. Chaudhuri	...	Several.
Streams in the Manipur Valley	S. L. Hora	...	...	20.

Measurements in millimetres.

Total length, including length of caudal	...	...	136.0
Length of caudal	...	...	25.0
Depth of body near origin of dorsal...	...	...	20.0
Length of head	...	...	23.5
Width of head	...	...	22.0
Diameter of eye	...	...	5.5
Length of snout	...	...	14.5

Interorbital width	...	...	...	11'0
Length of caudal peduncle	...	...	...	19'0
Height of caudal peduncle	...	...	...	12'5
Longest ray of dorsal	...	...	...	23'0
" " " anal	...	...	...	19'0
Length of pectoral	...	...	...	24'0
" " ventral	...	...	...	23'0

Garra jerdoni, Day.

1867. *Garra jerdoni*, Day, *Proc. Zool. Soc. London*, p. 288.
 1878. *Discognathus jerdoni*, Day, *Fish India*. II, p. 528, pl. cxxii, fig. 6.
 1889. *Discognathus jerdoni*, Day, *Faun. Brit. Ind. Fish.* I, p. 247.
 1919. *Discognathus elegans*, Annandale, *Rec. Ind. Mus.* XVIII, p. 76, pl. ix, fig. 4; pl. xi, fig. 5.
 1920. *Garra platycephala*, Rao, *Ann. Mag. Nat. Hist.* (9) VI, p. 56, pl. i, figs. 2, 2a, 2b.

This species is readily recognised by its flat or slightly concave head and by the presence of a large number of prominent tubercular areas on the otherwise smooth snout.

Rao described *Garra platycephala* from young specimens in which the tubercular areas are not raised and the snout, though marked by a large number of mucous pores, is uniformly flattened.

The air-bladder is much reduced; the following are its measurements in a female example 13'9 cm. in length:—

Length of anterior chamber	...	...	6'5 mm.
" " posterior "	...	...	5'0 mm.
Greatest diameter of anterior chamber	...	...	4'3 mm.
" " " posterior "	...	...	2'5 mm.

Specimens of this species were examined from the following localities:—

Bhavani R., Nilgiris, Madras	...	Purchased from Day	...	1.
Nierolay Stream, base of Nilgiris	...	N. Annandale	...	2.
Cavery R., Seringapatam, Mysore	...	C. R. Narayan Rao	...	1.

Garra annandalei, sp. nov.

1878. *Discognathus lamta*, Day (in part), *Fish. India* II, p. 527, pl. cxxii, fig. 4.
 1889. *Discognathus lamta*, Day (in part), *Faun. Brit. Ind. Fish.* I, p. 246, fig. 87.

The fish is almost subcylindrical with the head and body slightly depressed. The dorsal profile rises considerably from the tip of the snout to the base of the dorsal fin beyond which it gradually slopes to the base of the caudal fin. The ventral profile is straight throughout. The length of the head is contained 4'5 times and the depth of the body 4'5 to 5 times in the length of the fish without the caudal fin. The head is 1'2 times as long as wide. The eyes are laterally placed, slightly below the dorsal profile of the head, and are invisible from below; the diameter is contained 5'2 times in the length of the head and about 2'5 times in the length of the snout and in the interorbital width. The mouth

is small and is situated considerably behind the anterior end of the snout; the mental disc is well developed. There are two pairs of short barbels, shorter in length than the diameter of the eye; a distinct deep groove runs from the base of the rostral barbels to the angle of the mouth. The dorsal fin commences in advance of the ventrals and is distinctly nearer the tip of the snout than the base of the caudal fin, its longest ray is shorter than the depth of the body below it. The pectorals are shorter than the head and are separated from the ventrals by half of their own length. The ventrals extend beyond the anus but do not reach the base of the anal fin. The caudal fin is deeply emarginate; the caudal peduncle is 1.2 times as long as high. The lateral line is straight and runs almost in the middle of the body. There are 34 to 38 scales along the lateral line and 8 series of longitudinal rows of scales between the bases of the dorsal and ventral fins. There is a scaly sheath to the base of the dorsal and a scaly appendage to that of the ventrals. The scales are large but inconspicuous on the chest while they are fairly well marked on the belly.

The sides and the upper surface of the head and body, in spirit, are dark; the under surface is dirty white. The pectoral, dorsal and the caudal fins are dusky; the ventrals and the anal whitish. Some of the scales along the lateral line show a pinkish tinge in the centre.

Type-specimen.—F 10071/1, *Zoological Survey of India (Ind. Mus.)*.

There is a mature female purchased from Day which is labelled as having come from Assam. Several other specimens have recently been sent to us by Mr. G. E. Shaw from various streams at the base of the Darjiling Himalayas.

Measurements in millimetres.

		A.	B.
Length of fish without caudal	...	118	105.5
" " head	...	26	23
Width of head	...	21	18
Depth of body near origin of dorsal	...	23.5	23
Diameter of eye	...	5	4.5
Length of snout	...	13.2	11.7
Interorbital width	...	12.5	10.7
Length of caudal peduncle	...	18	17.5
Height of caudal peduncle	...	16	14
Longest ray of dorsal	...	20.5	21.5
" " " anal	...	17	17
Length of pectoral	...	23	19.6
" " ventral	...	19.5	19

***Garra mullya* (Sykes).**

- 1841. *Chondrostoma mullya*, Sykes, *Trans. Zool. Soc. London* II, p. 359, pl. lxii, fig. 3.
- 1844. *Discognathus fusiformis*, Heckel, in Hügel's *Kaschmir*, p. 387, figs.
- 1865. *Garra malabarica*, Day, *Proc. Zool. Soc. London*, p. 297.
- 1865. *Garra malabarica*, Day, *Fish. Malabar*, p. 205, pl. xv, fig 1.
- 1867. *Garra alta*, Day, *Proc. Zool. Soc. London*, p. 349.

1868. *Discognathus lamta*, Günther (in part), *Cat. Brit. Mus. Fish.* VII, p. 69.
 1878. *Discognathus lamta*, Day (in part), *Fish. India*, II, p. 527.
 1889. *Discognathus lamta*, Day (in part), *Faun. Brit. Ind. Fish.*, I, p. 247.
 1919. *Discognathus lamta*, Annandale, *Rec. Ind. Mus.*, XVI, p. 131, text-fig. 1, pl. ii, figs. 1, 1a.
 1919. *Discognathus jerdoni*, Annandale (*nec* Day) in part, *ibid.*, p. 132.
 1919. *Discognathus nasutus*, Annandale, (*nec* McClelland), *ibid.*, p. 132, pl. ii, figs. 2, 2a.
 1919. *Discognathus lamta*, Annandale, *Rec. Ind. Mus.* XVIII, p. 72.
 1919. *Discognathus jerdoni*, Annandale (*nec* Day) in part, *ibid.*, p. 73, pl. ix, fig. 2.
 1920. *Garra lamta*, Rao, *Ann. Mag. Nat. Hist.* (9) VI, p. 49.
 1920. *Garra jerdonia*, Rao, (*nec* Day) in part, *ibid.*, p. 53.
 1920. *Garra jerdonia* var. *brevimentalia*, *id.*, *ibid.*, pp. 54-56, pl. I, figs. 1a, 1b.

Garra mullya is the most widely distributed species of the genus in India: its range extends from Kathiawar, through the greater part of the Central Provinces, to the whole of Peninsular India. Consequent upon a wide range it shows a certain amount of variation. In some examples the disc is greatly reduced and its free borders represented by a short fringe. In one example from Bombay, the paired fins are extremely small and show a stunted growth. The form is fusiform and the snout is almost smooth.

Specimens of this species occurring in hill-streams are somewhat flattened and different looking. The air-bladder exhibits considerable variation and in the hill-stream forms it is usually reduced. The species seem to be still in process of adaptation to hill-stream life.

The following are the measurements of the bladder in a specimen from Malabar which is 10 cm. in length without the caudal fin:—

Length of anterior chamber	...	...	...	8.2 mm.
" " posterior "	...	...	...	17.5 mm.
Streams in Coorg, Mysore	...	C. R. Narayan Rao	...	Several.
Kavery Sangam, Mysore	...	B. L. Chaudhuri	...	8.
Malabar	...	Purchased from Day	...	1.
Tenmalai, Madras	...	N. Annandale	...	1.
Mettupalaiyam, Dist. Coimbatore, Madras.	...	"	...	2.
Nierolay Stream, base of Nilgiris, Madras.	...	"	...	1.
Cochin Forests, Madras	...	J. R. Henderson	...	12.
Yenna Valley, Satara Dist., Bombay.	...	N. Annandale and F. H. Gravely.	...	14.
Koyna Valley, Satara Dist., Bombay.	...	F. H. Gravely	...	1.
Medha, Satara Dist., Bombay	...	S. P. Agharkar	...	11.
Dhoni, near Wai, Krishna R., Bombay.	...	"	...	11.
Vashishti Valley, Ratnagiri Dist., Bombay.	...	F. H. Gravely	...	12.
Borivli, Thana Dist., Bombay	...	Bacteriological Laboratory, Bombay.	...	2.
Poona	...	Purchased from Day	...	1.
Khodmal Hills, Orissa	...	J. Taylor	...	6.
Chanda, C.P.	...	Mus. Coll.	...	1.
Birbhum	...	"	...	3.

Base of hills, Chakardhiarpur Sing- bhoom Dist., Chota Nagpur.	F. H. Gravely ...	...	2.
Pachmarhi, C.P. ...	A. Buchanan, W. H. Kenrick and F. H. Gravely.	Several.	
Near Sasan, Gir Forests, Kathia- war.	S. P. Agharkar...	...	2.
Streams in Girnar Mt., near Juna- gadh, Kathiawar.	„ ...	...	Several.
?	A.S.B. ...	...	1,

Garra lamta, Ham. Buch.

Plate XXIV, figs. 2, 2a.

1822. *Cyprinus* (*Garra*) *lamta*, Hamilton Buchanan, *Fish. Ganges*, pp. 343, 393.

D. 2/8. A. 2/5.

As has already been pointed out considerable confusion has centred round this historic species. Having now collected specimens from the type-locality I take this opportunity to define the species precisely. I have compared my specimens with Buchanan's manuscript drawing and find no difference between the two.

Garra lamta is a beautiful little Cyprinid fish with a fusiform body, highest near the origin of the dorsal and tapering towards both ends. The head and body is depressed but not greatly so. The length of the head is contained 4.7 times, of the caudal fin 5 times and the depth of the body 5.2 times in the length of the fish including the caudal fin. The head is 1.2 times as long as broad. The eyes are lateral and are situated slightly below the dorsal profile of the head, they are almost invisible from below. Their diameter is contained four times in the length of the head, twice in the interorbital width and 1.7 times in the length of the snout. In the female the eye is almost in the middle of the head, in the male, however, it is somewhat in the posterior half. The snout is smooth in the female while in the male it is provided with a short knob-like median proboscis in front of the nostrils; the tip of the snout is also marked off by a groove into a transverse lobe which is covered by spiny tubercles. Tubercles are also present on the sides of the snout in front of the nostrils. The mouth in both sexes is a small, slightly arched transverse opening on the under surface considerably behind the anterior end of the snout. In the male the mental disc is better developed. There are two pairs of short thread-like barbels. In the male the barbels are comparatively much longer than in the female; the rostral pair being longer than the diameter of the eye. The origin of the dorsal fin is nearer to the tip of the snout than to the base of the caudal; it is not so high as the depth of the body below it; the last undivided ray is the longest. In the female its free margin is truncate whereas in the male it is slightly concave. The ventrals are situated almost below the middle of the dorsal and their origin is equidistant from the tip of the snout and the base of the caudal fin in the male, while in the female it is much nearer to the

base of the caudal fin than to the anterior end of the snout. The pectorals are shorter than the head and are sharp in the middle. They are separated from the ventrals by a distance less than $\frac{1}{3}$ of their own length; the ventrals extend to the anal opening. The anal fin is short and almost reaches the base of the caudal, which is deeply emarginate. There are 30 to 31 scales along the lateral line and 8 longitudinal series of scales between the bases of the dorsal and ventral fins; a scaly appendage is only present near the base of the ventral fin in the female. The scales on the chest and the belly in the male are much reduced and, indeed, to the naked eye they appear almost absent; in the female conspicuous scales are present on the belly, but on the chest they are somewhat reduced.

The air-bladder, in the young specimens that I have examined, is quite normal; its length is contained about 3 times in the total length of the fish. The following are the measurements of the bladder in an immature male specimen 54.5 mm. in length :—

Length of anterior chamber	...	...	5 mm.
" " posterior "	...	...	9.5 mm.
Greatest diameter of anterior chamber	...	...	3.3 mm.
" " " posterior "	...	...	3.0 mm.

The following changes in the colour of the fish were noticed by keeping it living in water in a small dish :—" immediately after it was removed from the stream the fish was almost transparent, but shortly afterwards a black longitudinal streak was observed along the lateral line and above it was a whitish band running from behind the eye to the base of the caudal fin. An indistinct black blotch was also to be seen on the sides of the tail near the base of the caudal fin." On transferring the fish to weak alcohol, the upper surface was noticed to be greenish and the belly yellowish-white, the fins immaculate except for the few rays in the dorsal and the caudal fins which were streaked with black along their length. These observations were made on a female specimen in the field in October; but since then the specimens have changed considerably in spirit and there are marked differences in the colouration of the male and the female examples. In a female specimen the whole of the upper surface of the head and body is dusky and the ventral dirty white. There is also a longitudinal streak on the sides which begins in a prominent black spot near the upper margin of the gill-opening and ends in a rounded black blotch near the base of the caudal fin which is lightly streaked in the middle. In the male the general colouration is very much the same, but instead of a longitudinal black stripe there are 5 or 6 longitudinal wavy black lines, most conspicuous in the tail region, and the black blotch near the base of the caudal fin is replaced by a short vertical bar. There are minute black spots near the bases of the dorsal fin-rays and the membrane between these is also blackened in certain regions.

This species instead of having a very wide range, as stated by a number of authors, is restricted to the eastern part of the

Vindhya Range and the Nepal Terai. Buchanan procured some specimens from the Gorakhpur District, probably from the hill-streams.

Measurements in millimetres of a female specimen.

Total length including caudal	...	...	...	47.0 mm
Length of caudal	...	...	...	9.5 "
" " head	...	...	...	10.5 "
Width of head	...	...	...	8.0 "
Depth of body near origin of dorsal fin	...	...	...	9.0 "
Diameter of eye	...	...	...	2.6 "
Length of snout	...	...	...	4.4 "
Interorbital width	...	...	...	5.5 "
Length of longest ray of dorsal	...	...	...	8.0 "
" " " " " anal	...	...	...	7.5 "
" " pectoral	...	...	...	9.5 "
" " ventral	...	...	...	7.8 "
" " caudal peduncle	...	...	...	5.7 "
Height of " "	...	...	...	5.2 "

I have examined specimens of this species from the following localities :—

Bhaura Stream, Kharagpur Hills, South of Monghyr.	S. I. Hora	...	1.
Uttar Band, Man R., Kharagpur Hills, South of Monghyr.	"	...	1.
Katin Nallah, Kharagpur Hills, South of Monghyr.	"	...	6.
Maldhun, Nainital Dist., U.P.	Mus. Coll.	...	1.
Narsingpur, C.P.	Maj. W. H. Kenrick	...	1.
Chandli Deoli, C.P.	Col. Biddulph	...	5.

***Garra lissorhynchus* (McClelland).**

Plate XXVI, figs. 2, 2a.

1842. *Platycara lissorhynchus*, McClelland, *Calcutta Journ. Nat. Hist.* II, p. 587, pl. lxviii, fig.
 1868. *Discognathus macrochir*, Günther, *Cat. Brit. Mus. Fish.* VII, p. 70.
 1869. *Mayoa modesta*, Day, *Proc. Zool. Soc. London*, p. 553.
 1871. *Mayoa modesta*, Day, *Journ. As. Soc. Bengal* XL (2) p. 108, pl. ix, fig. 2.
 1878. *Discognathus modestus*, Day, *Fish. India* II, p. 528, pl. cxxii, fig. 5.
 1889. *Discognathus modestus*, Day, *Faun. Brit. Ind. Fish.* I, p. 247.

Günther seems to have been unaware of McClelland's *Platycara lissorhynchus*, as no reference is made to this species in his catalogue. McClelland described his species from specimens obtained in the Khasi Hills by Mr. Griffith and from page 574 of the volume cited above, it is clear that he forwarded one specimen "to the Museum at the India House." Günther's form was known to him from two examples, one from the collection of the East India Company and the other from Mr. Griffith's collection. The former example is probably that which was despatched to the India House by McClelland. Having examined numerous specimens from the Khasi Hills and after having carefully compared them with

the figures of McClelland and the description of Günther I find no difference between the various forms. I have also examined the type of Day's *D. modestus* from Northern India, and cannot separate it from other specimens from the Khasi Hills.

The head and body are greatly depressed in this species and the form resembles that of the species of the Homalopterid genus *Balitora*; it was probably the shape which led McClelland to regard it as a species of his genus *Platycara*. The species is also distinguished from other species of *Garra* by the fact that the chest and the middle of the abdomen are naked while big scales are present on the post-pelvic region. The pectoral fin is greatly expanded and is considerably longer than the head.

There is a marked difference in the colour of male and female specimens. In a female example the colour in spirit of the dorsal and lateral surfaces is dark livid grey, obscurely marbled with yellowish brown; the ventral surface is dull-yellowish. There is a dark streak near the free margin of the dorsal and a broad, black, **W**-shaped band on the anterior half of the caudal fin; an indistinct black blotch is present near the base of the caudal and a small black spot just behind the angle of the operculum. In the male the colour of the body is much lighter and the characteristic markings on the dorsal and the caudal fins are absent. The specimens from which the early descriptions were taken were in all probability males as no reference to the characteristic colouration of the female is made therein.

The air-bladder in this species has deviated considerably from the normal form. Not only is it much reduced but the posterior chamber has become thread-like and its walls are greatly thickened; the lumen of the chamber is almost obliterated. The anterior chamber is firmly fixed to the body-wall by a fibrous coat which covers it. In a mature female 56 mm. in length, the following are the measurements of the bladder:—

Length of anterior chamber	...	...	3.2 mm.
" " posterior "	...	...	3.0 mm.
Greatest diameter of anterior chamber	...	...	2.7 mm.
" " " posterior "	...	...	1.0 mm.

In Day's type of *modestus*, however, the bladder is better developed and corresponds more closely to the normal form. The following are its measurements:—

Length of specimen excluding caudal	...	...	70 mm.
" " anterior chamber	...	...	3.7 mm.
" " posterior "	...	...	5.0 mm.
Greatest diameter of anterior chamber	...	...	3.0 mm.
" " " posterior "	...	...	2.0 mm.

I have examined specimens of this species from the following localities:—

Nong-priang Stream, Cherrapunji	...	B. Warren	...	8.
Northern India (?)	...	Purchased from Day	...	1.
Assam	...	Mus. Coll.	...	1.
Jaintia Hills, Assam	...	Col. Godwin Austen	...	3.

Measurements in millimetres.

Total length including caudal	...	...	...	90	mm.
Length of caudal	...	...	...	18.5	"
" " head	...	...	...	16.2	"
Width of head	...	...	...	15.5	"
Depth of body near base of dorsal...	...	...	...	14.5	"
Diameter of eye	...	...	...	3.7	"
Length of snout	...	...	...	8.5	"
Interorbital width	...	...	...	8.0	"
Length of caudal peduncle	...	...	...	12.0	"
Height of caudal peduncle	...	...	...	9.5	"
Longest ray of dorsal	...	...	...	14.0	"
" " " anal	...	...	...	17.5	"
Length of pectoral	...	...	...	14.5	"
" " ventral	...	...	...	11.5	"

Garra abhoyai, sp. nov.

Plate XXVI, figs. 1, 1a, 1b.

D. 2/6—7. P. 15—16. V 9. A. 1/5.

The fish has a characteristic fusiform body; the dorsal profile rises considerably from the tip of the snout to the origin of the dorsal fin, beyond which it slopes down to the base of the caudal; the ventral is almost straight and horizontal in front of the anal fin, beyond which it slightly rises to the base of the caudal. The under surface of the head and body is flat, but the fish as a whole is not greatly depressed. The length of the head is almost equal to the depth of the body in front of the base of the dorsal and is contained 4.3–4.6 times in the length of the fish. The eyes are almost lateral in position and are situated slightly below the dorsal profile of the head; they are placed somewhat in the posterior half of the head and are invisible from below. The diameter of the eye is contained 4.6 times in the length of the head, 3.3 times in the length of the snout and 3.3–3.6 times in the interorbital width. The snout is smooth and the nostrils are placed considerably nearer to the eye than to the tip of the snout. The mouth is a slightly arched, transverse opening on the under surface and is provided with a well-marked almost circular disc. There are two pairs of short barbels; they are shorter than the diameter of the eye. The lateral line is straight and runs along the middle of the body; there are 33 to 35 scales along the lateral line. On the sides and on the dorsal surface behind the dorsal fin, the scales are well-marked and their boundaries easily distinguishable, while in front of the dorsal fin they are much reduced and, indeed, to the naked eye the surface appears to be absolutely devoid of any scales. The under surface in front of the ventrals is naked but ill-defined scales are present between the bases of the ventral and anal fins. The dorsal fin commences almost in the middle of the distance between the tip of the snout and the base of the caudal fin; the second branched ray is the longest; it is not as high as the depth of the body below it; its free margin is almost truncate. The ventrals commence below the 4th ray of the dorsal. The pectorals

are shorter than the head and are separated from the ventrals by a distance equal to the base of the dorsal fin. Both the paired fins are horizontally placed and are provided with muscles on the ventral aspect of some of the outer rays. The anal fin is considerably removed from the anal opening and its longest ray is twice as high as the shortest. The caudal fin is evenly lobed and deeply emarginate.

The air-bladder is reduced; it is not greatly modified in form. The following are its measurements in a mature female specimen 65 mm. in length without the caudal fin:—

Length of anterior chamber	...	...	3.5 mm.
" " posterior "	...	...	5.0 "
Greatest diameter of anterior chamber	...	...	2.8 "
" " " posterior "	...	...	1.5 "

The fish has a characteristic colouration. The upper surface of the head and body are dusky, while the ventral surface and the fins are dirty white. There is a light black bar across the dorsal and a **W**-shaped black marking on the caudal fin.

Locality.—Three specimens were sent to the Indian Museum by Mr. Pettigrew from Manipur, Assam; Dr. N. Annandale informs me that Pettigrew made his collection in the neighbourhood of Ukhral, which is situated at an altitude of 6000 ft. among the Naga Hills.

Type-specimen.—F 5307/1, Zoological Survey of India (Ind. Mus.).

Annandale (1913, p. 37) recognised this species to be an undescribed form, but he then considered it a race of *lamta* and did not attempt to describe it. He pointed out, however, that the Manipur race "has the whole of the ventral surface devoid of scales and exhibits marked peculiarities in colouration."

Measurements in millimetres.

	A.	B.	C.
Total length excluding caudal	65	61	64.5
Length of head	14	14	14
Depth of body near base of dorsal	14.5	13.5	13
Diameter of eye	3	3	3.3
Length of snout	7	7	7
Interorbital width	8	7.3	7.5
Length of caudal peduncle	12.5	11.5	9.5
Height " " "	8.2	7	7.5
Longest ray of dorsal	11	11.6	11.7
" " " anal	10.5	10	10.7
Length of pectoral	13.5	11.5	12.5
" " ventral	12	10.6	11.5

Specimens A and C are females full of eggs; I have not opened B and, therefore, cannot give its sex.

Garra kempī, sp. nov.

Plate XXVI, figs. 3, 3a.

D. 2/8. A. 2/5. P. 13. V 8.

In this fish the head and body are greatly depressed and flattened so that the dorsal and ventral profiles are slightly arched in front of the ventrals, beyond which they gradually slope to the base of the caudal fin. The tail is thick and narrow and almost whip-like. The head is almost squarish, its breadth being contained 1.2 times and its height 1.6 times in the length. The depth of the body is contained 5.6 times and the length of the head 4.5 times in the length of the fish without the caudal fin. The eyes are small, occupy a dorso-lateral position, and are invisible from below. They are situated somewhat in the posterior half of the head; their diameter is contained 5 times in the length of the head, 2 times in the length of the snout and 2.4 times in the interorbital width, their superior margin is in line with the dorsal profile of the head. The snout is broad and semicircular; the nostrils are situated in its posterior half. Slightly in front of the nostrils on both sides is a whitish bony area which is somewhat raised from the general surface. There are two pairs of short thick barbels, the rostral being slightly longer than the diameter of the eye. The mouth-opening is greatly arched and is as wide as the breadth of the head. The mental disc is well-developed and is 1.5 times as broad as long. The tubercles on the labial fold and on the free border of the mental disc are minute. The gill-openings extend on the under surface for a short distance and the branchiostegal rays are not visible.

The origin of the dorsal fin is nearer to the tip of the snout than to the base of the caudal fin. Its first divided ray is the longest and is higher than the depth of the body below it. The ventrals originate slightly behind the dorsal and their origin is also slightly nearer to the anterior end of the snout than to the base of the caudal fin. The paired fins are broad and horizontally situated. The pectorals are as long as the head and are provided with thick pads of muscles on the ventral surface of some of the outer rays; they are separated from the ventrals by a considerable distance. The ventrals extend beyond the anus, but do not reach the base of the anal fin which in its turn does not reach the base of the caudal fin. The anus is raised on a papilla and is situated almost midway between the origin of the ventral and anal fins. The lateral line is almost in the middle of the body and runs straight from the angle of the operculum to the middle of the base of the caudal fin. The scales are rather small; there are 39 scales along the lateral line and 8 longitudinal series of scales between the bases of the dorsal and the ventral fins. The scales are absent on the chest and are much reduced on the belly along the middle line. The caudal peduncle is 1.8 times as long as high.

The air-bladder, though greatly reduced, does not show any special modification in the form of a thick coating, etc. The following are the measurements of the bladder in the type-specimen which is about 9 cm. in length including the caudal:—

Length of anterior chamber	...	...	4.5 mm.
" " posterior "	...	...	4.0 "
Greatest diameter of anterior chamber	...	...	3.0 "
" " " posterior "	...	...	1.3 "

The colour of the upper surface of the body and head is blackish, as is also that of the dorsal, caudal and upper surface of the paired fins. On the under surface it is dirty white. The scales are distinctly edged with black.

Type specimen.—F 7716/1, Zoological Survey of India (Ind. Mus.).

Locality.—Only one specimen has been examined, procured by Dr. S. W Kemp in Siyom R., below Damda at an altitude of 1300 ft., among the Abor Hills.

Measurements in millimetres of the type-specimen.

Length of fish including length of caudal	...	...	89.5
" " head	...	...	20.0
Width of "	...	...	17.0
Depth of body near origin of dorsal	...	...	16.0
Diameter of eye	...	...	4.0
Length of snout	...	...	8.0
Interorbital width	...	...	9.8
Length of mouth-opening	...	...	12.0
Length of callous portion of disc	...	...	6.5
Width " " " " "	...	...	9.5
Distance of anus from anterior end of snout	...	...	54.0
Length of caudal peduncle...	...	...	18.5
Height of caudal "	...	...	10.0
Length of pectoral fin	...	...	19.7
" " ventral " "	...	...	17.5

Garra naganensis, sp. nov

Plate XXV, figs. 2, 2a.

D. 2/7. A. 1/5. P. 14. V 8.

The dorsal profile in this fish rises from the tip of the snout to the base of the dorsal fin beyond which it runs straight to the base of the caudal fin; the ventral is somewhat convex. The head is flattened on the under surface and is 1.2 times as long as broad; its length is contained 4.9 times in the length of the fish without the caudal. The depth of the body near the origin of the dorsal fin is equal to the length of the head. The eyes are almost in the posterior half of the head and look outwards and upwards; their diameter is contained 4 times in the length of the head, 2.1 times in the length of the snout and 2 times in the interorbital width. The snout is broad and semicircular and the nostrils are situated in its posterior third. There are two pairs of short barbels, shorter than the diameter of the eye in length. The mouth is on the under surface considerably behind the anterior end of the snout and is provided with well-developed upper and lower labial folds. The mental disc is oval, its longitudinal diameter being half the transverse diameter. The origin of the dorsal fin is

much nearer the end of the snout than the base of the caudal fin; it is not so high as the depth of the body below it. The ventrals commence below the middle of the dorsal fin and their origin is equidistant from the base of the caudal fin and the tip of the snout. The pectorals are as long as the head and are sharp in the middle; they are separated from the ventrals by a distance which is more than half of their own length. The third ray of the ventral fin is the longest; the fin extends beyond the anal opening, which is situated nearer to the origin of the anal than to that of the ventral. The anal fin is short and does not reach the base of the caudal fin. The caudal fin is evenly lobed and deeply emarginate. The lateral line is straight and runs almost in the middle of the body; there are 39 scales along its length and 8 series of longitudinal scales between the bases of the dorsal and anal fins. The scales are absent near the bases of the pectoral fins and are greatly reduced on the chest and in the middle of the abdomen; large scales are present in the post-pelvic region.

The air-bladder is greatly reduced and the posterior chamber is narrow and long. In a specimen 98 mm in length, the following are the measurements of the bladder:—

Length of anterior chamber	...	...	5.3 mm.
" " posterior "	...	...	10.5 "
Greatest diameter of anterior chamber	...	...	3.8 "
" " " posterior "	...	...	1.3 "

The colour on the upper surface and the sides is black, on the under surface whitish. The dorsal and the caudal fins are dusky as is also the dorsal surface of the paired fins. The anal and the under surface of the paired fins are whitish. There is a minute black spot behind the angle of the operculum.

Type-specimen.—F 9970/1, Zoological Survey of India (Ind. Mus.).

Locality.—A single specimen was obtained by myself in the Senapati Stream near Kairong, among the Naga Hills, Assam, in February, 1920.

Measurements in millimetres.

Total length without the caudal	...	...	98
Length of head	...	...	20
Depth of body near origin of dorsal	...	...	20
Width of head	...	...	16.5
Diameter of eye	...	...	5.0
Length of snout	...	...	10.5
Interorbital width	...	...	10.0
Length of caudal peduncle	...	...	20.0
Height of caudal peduncle	...	...	12.5
Distance of vent from anterior end of snout	...	...	62.5
Length of callous portion of disc	...	...	4.0
Width " " " "	...	...	7.5
Longest ray of dorsal fin	...	...	16.0
" " " anal "	...	...	17.0
Length of pectoral fin	...	...	20.0
" " ventral "	...	...	18.0

***Garra prashadi*, sp. nov.**

Plate XXIV, fig. 3.

D. 3/7—8. A. 2/5. V 8—9. P. 13.

The fish is subcylindrical with the head and body somewhat flattened on the under surface. The dorsal profile rises considerably from the tip of the snout to the origin of the dorsal fin, beyond which it gradually slopes to the base of the caudal; the ventral profile is straight and horizontal in front of the anal fin, beyond which it rises to the base of the caudal. The head is short and bluntly pointed; its length is contained 4.5 to 5 times in the length of the fish without the caudal fin; the head is almost 1.1 times as long as broad. The depth of the body near the origin of the dorsal fin is slightly greater than the length of the head. The eyes are lateral and are in the upper half of the head; their diameter is contained 4.3 times in the length of the head and 2 to 2.1 times in the length of the snout and in the interorbital width. The eyes are situated slightly in the posterior half of the head. The mouth is on the under surface, somewhat behind the tip of the snout; its gape is half as broad as the width of the head. The mental disc is comparatively small but is well developed. There are two pairs of short barbels, shorter than the diameter of the eye. The dorsal fin commences nearer the tip of the snout than the base of the caudal fin; it is almost as high as the depth of the body below it. The ventrals are situated below the middle of the dorsal and their commencement is midway between the tip of the snout and the base of the caudal fin. The pectorals are longer than the head and are horizontally placed; they are sharp in the middle and are separated from the ventrals by half their own length. The ventrals extend to the anus and are provided with scaly appendages near their bases. The anal is considerably removed from the ventrals and does not extend to the base of the caudal fin. The caudal fin is deeply emarginate; the caudal peduncle is 1.2 times as long as high.

The air-bladder is minute but of the normal Cyprinid type. In a male specimen 82 mm. in length the following are its measurements:—

Length of anterior chamber	...	...	5.5 mm.
" " posterior "	...	...	6.5 "
Greatest diameter of anterior chamber	...	...	4.0 "
" " " posterior "	...	...	1.2 "

The scales in *Garra prashadi*, though well developed, are rather obscure. I have been able to make out 32 along the lateral line and 6½ longitudinal series of scales between the bases of the dorsal and the ventral fins. The scales are poorly developed on the abdomen and are absent on the chest.

The colour is rather characteristic, the dorsal surface of the head is dusky; it is dirty white on the under surface. The upper surface of the body and its sides above the lateral line are

dark, the rest of it and the paired and the anal fins whitish. The dorsal and the caudal fins are dusky, the latter with an oblique black longitudinal bar on its lower lobe. There is a black spot behind the angle of the operculum and a short obscure black bar near the base of the caudal. On the sides of the tail are a number of black, wavy longitudinal lines.

Type specimen.—F 9971/1, Zoological Survey of India (Ind. Mus.).

Locality.—Only three specimens of this interesting species have been examined; they were obtained in Malwa Tal, U.P., in May, 1920, by Dr. Baini Prashad and myself.

Measurements in millimetres.

	A.	B.
Length of fish without caudal	82	71
" " head	16.5	15.7
Width " "	14	13.3
Depth of body near origin of dorsal	17.5	16
Diameter of eye	3.8	3.6
Length of snout	7.5	8
Interorbital width	8	6.9
Length of caudal peduncle	13	11.5
Height of " "	10.6	9.4
Longest ray of dorsal	17.5	15
" " " anal	15.5	13.5
Length of pectoral	19.5	16.5
" " ventral	17	14

Garra notata (Blyth).

1860. *Platycara notata*, Blyth, *Journ. As. Soc. Bengal*, XXIX, p. 161.

To this species I refer three young specimens collected by Major Berdmore in Tenasserim, Burma. Blyth's description of the species is inadequate and I therefore take this opportunity to add a few notes to it.

D. 2/7—8. A. 2/5. P. 14—15. V 9.

In *Garra notata* the under surface of the head and body are greatly flattened and the ventral profile is straight and horizontal throughout. The dorsal profile is arched, it rises from the tip of the snout to the base of the dorsal fin, beyond which it slopes down to the base of the caudal. The head is almost one and a half times as long as broad; its length is contained 4.1 times in the length of the fish without the caudal fin and is slightly greater than the depth of the body near the origin of the dorsal fin. The eyes are almost lateral but invisible from below; their diameter is contained about 3.3 times in the length of the head, 1.3–1.9 times in the length of the snout and 1.8 times in the interorbital width. There are two pairs of thread-like barbels, the rostrals are longer than the diameter of the eye; the maxillary are very small and liable to be overlooked. The eye is situated almost in the middle of the head or slightly nearer to its posterior margin.

The origin of the dorsal is almost equidistant from the tip of the snout and the base of the caudal fin or it is somewhat nearer to the former. The scales in front of the ventrals on the under surface are greatly reduced and, indeed, to a superficial observer may appear to be almost absent. There are 33-34 scales along the lateral line and 8 series of longitudinal rows of scales between the bases of the dorsal and ventral fins.

The colour has undergone considerable change as the specimens have been preserved in spirit for a long time. Except for the under surface in front of the ventrals and the cheeks, which are whitish, the fish is dark brown. There is a black spot near the angle of the operculum and a series of black markings at the base of the dorsal fin-rays.

Blyth describes the colouration of the fish as follows:—"Colour dusky olive-green above and on the sides, beneath buffy-albescent. Base of the dorsal fin whitish, setting off a series of black spots, larger anteriorly and the hindmost generally obsolete: rest of the fin a little nigrescent. One or more spots also at base of the anal fin. Pectorals somewhat yellowish at base, then blackish; a dusky line along each longitudinal row of scales becoming gradually visible towards the tail." The colouration was noted from a specimen about 6 in. in length.

Measurements in millimetres.

Length of fish without caudal ...	...	...	54	54.5
" " head ...	...	...	13	13.5
Width of head ...	...	...	9	9.6
Depth of body ...	...	...	12.5	13.5
Diameter of eye ...	...	...	3	3.2
Length of snout ...	...	...	5.7	5.3
Interorbital width ...	...	...	5.5	6
Length of caudal peduncle ...	...	...	9.5	9.2
Height " " "	...	...	6	6.7
Longest ray of dorsal ...	...	...	11	10.7
" " " anal ...	...	...	8	9.7
Length of pectoral ...	...	...	11.7	12.5
" " ventral ...	...	...	8.2	10

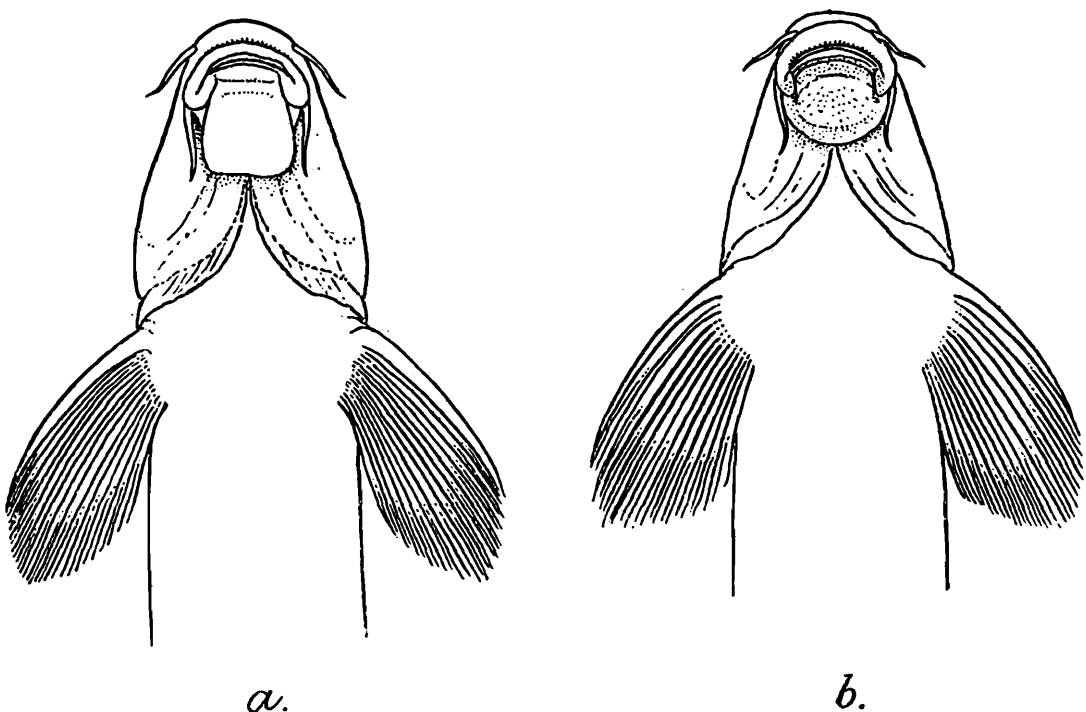
***Garra chaudhurii*, sp. nov.**

Plate XXV, fig. 3.

D. 2/7-8. A. 2/5. P. 13-15. V 8.

This species is represented by small individuals from the Darjiling District of Northern Bengal. The head and body are depressed and the ventral profile is almost straight; the dorsal profile is arched and slopes considerably on both sides from the origin of the dorsal fin. The head is conical and is 1.3 times as long as broad; its length is contained from 4.1 to 4.9 times in the length of the fish without the caudal. The depth of the body is as much greater than the width of the head as it is less than its length. The eyes are almost lateral and are invisible from be-

low. They are situated nearer to the tip of the snout than to the posterior margin of the operculum; their diameter is contained from 4.6 to 5.7 times in the length of the head, 2–2.1 times in the length of the snout and 2.1–2.6 times in the interorbital width. There are two pairs of barbels, longer than the diameter of the eye. The snout is smooth and the nostrils are situated nearer the margin of the orbit than to the tip of the snout. The mouth-opening is somewhat arched and is situated slightly behind the tip of the snout. The mental disc exhibits considerable variation in the three adult specimens examined. In the ripe female it corresponds to developmental stage 4 and consists of a rectangular pad behind the mouth which is separated by a faint line of demarcation into an anterior portion, the posterior labial fold, and



TEXT-FIG. 4.—Form of mental disc in two ripe specimens of *Garra chaudhurii*, sp. nov.

the posterior portion, the disc proper. In the other two male specimens it is more marked, but the true lips are still visible and the various components of the disc are not well differentiated. The origin of the dorsal fin is slightly nearer to the tip of the snout than to the base of the caudal fin and its longest ray is as high as the depth of the body below it. The pectorals are shorter than the length of the head and are separated from the ventrals by a considerable distance.

In spirit the specimens have lost their natural colouration. They are dusky on the body above the lateral line and on the upper surface of the head. The rest is dirty white and the cheeks are whitish.

The air-bladder is of the normal Cyprinid type; its length is contained 2.8 times in the length of the fish without the caudal fin.

The scales are poorly developed on the under surface and are

greatly reduced anteriorly. There are 32-33 scales along the lateral line and 8 series of longitudinal rows of scales between the bases of the dorsal and ventral fins.

Type-specimen.—F 8146/1, Zoological Survey of India (Ind. Mus.).

Locality.—There are three specimens of this species from the Darjiling District, presented to the Indian Museum by Dr. Walker.

Measurements in millimetres.

Length of fish without caudal	...	...	53.2	56.2
" " head	...	...	13	11.4
Width " "	...	...	9.6	8.2
Depth of body	...	...	11.5	9.9
Diameter of eye	...	...	2.8	2
Length of snout	...	...	5.6	4.2
Interorbital width	...	...	6	5.3
Length of caudal peduncle	...	...	9.6	8.0
Height " " "	...	...	7	6.7
Longest ray of dorsal	...	...	11.7	9.6
" " " anal	...	...	10.2	7
Length of pectoral	...	...	11.7	10
" " ventral	...	...	10	8

***Garra jenkinsonianum*, sp. nov.**

Plate XXV, fig. 1.

1910. *Discognathus lamta*, Jenkins, *Rec. Ind. Mus.* V, p. 128.

D. 2/8. A. 1/5. P. 12-14. V. 8-9.

In *Garra jenkinsonianum* the dorsal profile is greatly arched; it rises from the tip of the snout to the base of the dorsal fin, beyond which it slopes gradually to the base of the caudal. The ventral profile is straight and horizontal throughout. The head is somewhat flattened on the under surface and is short and bluntly pointed; its length is contained 4.3 times in the length of the fish without the caudal and it is 1.2 times as long as broad. The body is slightly flattened; its depth near the origin of the dorsal fin is almost equal to the length of the head. The eyes are situated almost in the middle of the head and are lateral in position; they are slightly visible from above and almost invisible from below. The diameter of the eye is contained 4.3 times in the length of the head, 1.8 times in the length of the snout and 2.1 times in the interorbital width. The mouth is small and slightly arched; it is not situated far behind the tip of the snout. The mental disc is small but its various parts are well-marked. There are two pairs of short barbels; their length is shorter than the diameter of the eye. The snout is smooth and rounded, but near the tip it is marked off into a small lobe by two short transverse grooves. The origin of the dorsal is nearer the tip of the snout than the base of the caudal fin; it is considerably in advance of the ventral; its longest ray is shorter than the depth of the body below it and its free margin is almost straight. The pectorals are

shorter than the head and are separated from the ventrals by a distance less than $\frac{1}{3}$ of their length. The ventrals are situated at an equal distance from the base of the caudal fin and the tip of the snout; they extend to beyond the anal opening. The anal does not reach the base of the caudal fin, which is slightly emarginate. The lateral line is straight and runs along the side of the fish somewhat nearer to the dorsal than to the ventral surface, there are 33-34 scales along its length and $7\frac{1}{2}$ series of longitudinal rows of scales between the bases of the dorsal and the ventral fins. The scales are absent on the chest but are quite normal on the belly. The anus is situated in the beginning of the last third of the distance between the origin of the ventral and the anal fins.

The air-bladder in this species is of the normal Cyprinid type, its length is contained 2.7 times in the length of the fish without the caudal.

The sides and the upper surface of the head and body are darkish with an indistinct greyish band along the lateral line on each side. The under surface is dull white. There is a distinct black spot just behind the angle of the operculum.

Type specimen.—F 5736/1, Zoological Survey of India (Ind. Mus.).

Locality.—Numerous specimens were obtained by Dr. Jenkins and Dr. Annandale in Sita Nullah, Paresnath Hills, Bengal.

Measurements in millimetres.

	A.	B.
Length of fish without caudal	63	60
" " head	15	14
Width " "	11.5	11
Depth of body	15.3	14.6
Diameter of eye	3.5	3.2
Length of snout	6.4	5.3
Interorbital width	7.5	7
Length of caudal peduncle	10	12
Height of " "	8	8.4
Longest ray of dorsal	11.8	11.5
" " " anal	10.5	10.5
Length of pectoral	14	14.5
" " ventral	11.6	11.5
Sita Nullah, Paresnath Hills...	Dr. Jenkins and Dr. Annandale...	14.
" " " "	Dr. Jenkins	2.

***Garra rupeculus*¹ (McClelland).**

Plate XXIV, fig. 1.

1839. *Gonorhynchus rupeculus*, McClelland, *Asiatic Res.* XIX, pp. 281, 343, pl. xliii, figs. 4, 5.

1839. *Gonorhynchus brachypterus*, McClelland, *ibid.*, pp. 283, 374.

McClelland described both the species from the "Mishmee Mountains" where they were obtained by Mr. Griffith. McClelland

¹ When giving a synopsis of the species on page 281 and 283 McClelland spells the name of this species as *rupiculus*, while in the description on page 343. he spells it *rupeculus*.

himself doubted whether the two forms were specifically distinct as on p. 283 (footnote) of the work cited above he remarks of *G. brachypterus*,—"It also agrees with that species (*G. rupeculus*) in the form of its fins; the presence of two very minute cirri being my chief reason for separating them, I have not thought it necessary to give a figure." Having collected a large number of examples of this species, I do not find myself justified in accepting the two forms as distinct species. The barbels are, undoubtedly, very minute and are apt to be overlooked. As a matter of fact there are four short barbels, of which McClelland could see only two in certain individuals. Since the publication of Günther's Catalogue (1868) both these species have been placed under the synonymy of *G. lamta* by several ichthyologists without comment. Some of my specimens, though none of them is more than 2 inches in length, are ripe females as they have been found on dissection to contain eggs. This species is a characteristic hill-stream form.

The species is readily distinguished by its small size, depressed body and head and almost straight profile. The length of the head is contained 4.5-5 times, the depth of the body near the origin of the dorsal fin 5.3-6.9 times in the length of the fish including the caudal fin. The head is 1.2 times as long as broad. The eyes are dorso-lateral and are situated in the middle of the head; their upper margin is in line with the dorsal profile of the head. There are two pairs of minute barbels. The mouth is provided with well-developed labial folds and the mental disc is well-marked. There are rows of open pores on the snout, one extending from the antero-inferior margin of the eye to its tip and another from behind the disc on the under surface, coming upwards and backwards and ultimately continued along the lateral line. The origin of the dorsal fin is slightly nearer to the base of the caudal than to the tip of the snout; it contains six branched rays besides one or two that are not branched. The pectorals are horizontal and rounded, they are shorter than the length of the head and are widely separated from the ventrals. Both the paired fins are horizontally placed and are provided with muscles on the under surface of some of their outer rays. The ventrals extend considerably beyond the anus. The lateral line is straight and runs nearer to the dorsal than to the ventral surface. There are 32-34 scales along the lateral line and 9 longitudinal series of scales between the bases of the dorsal and ventral fins. The ventral surface is naked.

The air-bladder is normal in form. In a specimen 30 mm. long, the following are the measurements of the bladder.

Length of anterior chamber	...	...	...	2.2 mm
" " posterior "	"	"	"	3.0 "
Greatest diameter of anterior chamber	...	...	...	2.5 "
" " " posterior "	"	"	"	1.2 "

The colour is variable; generally it is black on the upper surface and sides of the body and white below. The fins are all

white, except for a light black streak near the free margin of the dorsal and a wavy band in the middle of the caudal fin. There is a deep black bar across the base of the dorsal and this in some specimens is preceded by a narrow white streak. In certain examples the colour below the lateral line is very light while in others a deep black longitudinal band is present along the lateral line and both the surfaces above and below it are light in colour.

Locality.—My specimens were collected in the hill-streams of the Manipur Valley, Assam. It is also known from the adjacent Mishmi Hills.

Measurements in millimetres.

	A.	B.	C.	D.	E.	F.
Length of fish including caudal fin ...	29.8	30	30.2	34.4	30.7	29.7
Greatest depth of body ...	4.3	4.4	4.6	6.4	4.4	5.2
Length of head ...	6.2	5.8	6.1	7.2	6.3	6.2
Width of head ...	4.8	4.8	4.8	5.4	4.8	4.4

Garra sp.

I am indebted to my friend Mr. Prashar Bhatia for a young specimen of *Garra* from the neighbourhood of Bannu City, which is situated very near Waziristan. The specimen is only 37 mm. in length and differs from *G. wanae* in the following respects:—

- (i) The eyes are partly visible from below.
- (ii) The origin of the dorsal fin is slightly nearer to the tip of the snout than to the base of the caudal fin.
- (iii) There is a well-developed free tubercular border to the disc with the posterior and lateral edges free.
- (iv) There is a round black spot on either side of the tail near the base of the caudal fin.

I have not thought it proper to describe a new species on the basis of a single, probably immature, individual.

PART 2. ON SOME EXTRA-INDIAN SPECIES OF
GARRA.

While revising the Indian species of *Garra* I have also examined some specimens of this genus from outside India proper in the collection of the Indian Museum. The specimens dealt with in this part are from the following localities:—

- (i) Five specimens (F 8120—24/1) from Lahej near Aden.
 - (ii) One specimen (No. 9405) from Baluchistan.
 - (iii) Nine specimens (F 8125—33/1) from the Lake of Tiberias, Palestine.
 - (iv) Numerous specimens (F 8174—95/1) from the Kushk River, Afghanistan.
 - (v) Topotypes of *G. blanfordi* (F 8108—8119/1) from Abyssinia.
 - (vi) Type-series of *G. adiscus* from Seistan.
- Except *G. adiscus* (Annandale), all have been referred by

various authors to *Garra lamta*. Blanford¹ referred those from Lahej near Aden to the latter species on the authority of Günther Annandale,² while recognising that the Palestine species was distinct from the Indian one, considered it merely a local race of *G. lamta* which he called *rufus* (Heck.). Both Lortet³ and Tristram⁴ also described and figured their examples from Palestine as *G. lamta*,⁵ while Jenkins⁶ referred the Baluchistan specimen to the same species without comment. The Abyssinian form previously referred to *G. lamta* by Blanford (*op. cit.*, p. 460) and Vinciguerra⁷ has been separated by Boulenger⁸ under the name *G. blanfordi*. Numerous examples collected between the Helmand and the Kushk Rivers in Afghanistan were recorded by Günther⁹ himself as *G. lamta*, but Boulenger in the paper cited above has referred the same specimens to *G. variabilis*, Heck., of which he regards Nikolski's¹⁰ *G. rossicus* as a synonym.

In my opinion the Arabian form must be described as a new species. I agree with Boulenger and Annandale as regards those from Abyssinia and Seistan, while *G. rufus* seems to me to be specifically distinct. The single specimen from Persian Baluchistan probably represents an undescribed species, but I prefer not to name it on the basis of a single individual. Boulenger in the paper cited above gives a very wide interpretation to the species *G. variabilis* (Heck.), in which Tate Regan¹¹ also included the form recently described by Annandale¹² as *G. phryne*. Mr. Tate Regan has, however, recently informed us that there are no specimens in the British Museum that he can refer to *G. variabilis*, and it is clear that several allied forms are capable of specific separation.

Garra arabica, sp. nov.

1870. *Discognathus lamta*, Blanford (in part), *Geol. Zool. Abyssinia*, p. 461.

D. 3/8. A. 2/5. V. 9. P. 14—15.

Garra arabica is a fairly stout fish with the dorsal profile arched and the ventral almost horizontal and straight in front of the anal fin, beyond which it rises to the base of the caudal fin. The head and body are somewhat depressed. The length of the head is contained 4 to 4.3 times and the depth of the body 3.6 to 4

¹ *Geol. Zool. Abyssinia*, p. 461 (1870).

² *Journ. As. Soc. Bengal* (n.s.) IX, p. 37, fig. 2 (1913).

³ *Arch. Mus. d'Hist. Nat. Lyon* III, p. 153, pl. xvi, figs. 4, 5 (1883).

⁴ *Faun. Flor. Palest.*, p. 172, xix, fig. 3 (1884).

⁵ The specimen figured by Lortet is quite distinct from Annandale's Palestine specimens.

⁶ *Rec. Ind. Mus.* V, p. 124 (1910).

⁷ *Ann. Mus. Genova* XVIII, p. 695 (1883).

⁸ *Proc. Zool. Soc. London* II, p. 160 (1901).

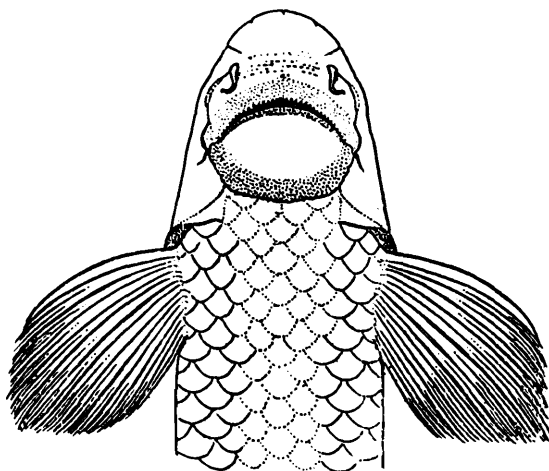
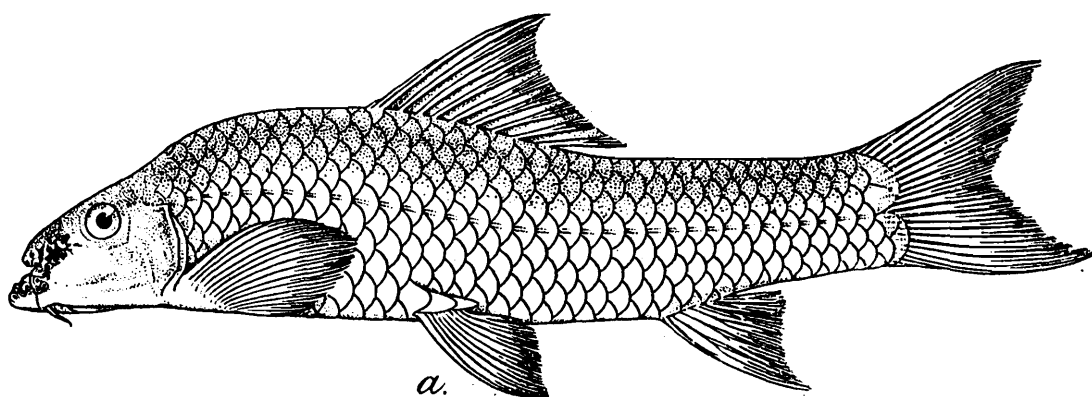
⁹ *Trans. Linn. Soc.* (2) V, p. 170 (1889).

¹⁰ *Ann. Mus. Zool. Acad. Petersbourg* V, p. 239 (1900).

¹¹ *Journ. As. Soc. Bengal* II, p. 8 (1906).

¹² *Rec. Ind. Mus.* XVIII, p. 70, pl. x, fig. 3 pl. xi, fig. 2.

times in the length of the fish without the caudal fin. The head is 1.3 times as long as broad. The eye is in the posterior half of the head and is contained 4.5 to 5 times in the length of the head, 2.4 to 2.8 times in the length of the snout and 1.7 to 2 times in the interorbital width. The eyes are dorso-lateral in position and are invisible from below. The snout projects considerably beyond the mouth and the mental disc is well developed. The tubercles on the labial fold and also on the free borders of the disc are comparatively minute. The upper labial fold is fringed. The gape of the mouth is slightly less than half the length of the head. There are two pairs of barbels; those at the angle of the mouth are very



TEXT-FIG. 5.—Lateral view and under surface of head of *Garra arabica*, sp. nov.
 a. Lateral view of type-specimen.
 b. Under surface of head of same.

small. The length of the rostral barbels is less than the diameter of the eye. There are 33 to 34 scales along the lateral line and 9 longitudinal rows between the bases of the dorsal and the ventral fins. There are three and a half rows of scales between the lateral line and the root of the ventral. The scales are feebly developed in the region of the chest and also form appendages to the bases of the ventrals. The dorsal fin is situated slightly in advance of the ventrals; its first divided ray is the longest and its free margin is concave. Its origin is much nearer to the tip of the snout than to the base of the caudal. The pectoral fin is sharp in the middle and is as long as the head. It is separated from the ventrals by

half its own length. The ventrals extend beyond the anus but the anal does not reach the base of the caudal fin.

In adult specimens there is always a well-developed proboscis, studded with hollow tubercles projecting in front of the nares on the snout. Similar hollow tubercles are also present on other parts of the snout.

The air-bladder is much reduced and the two chambers are separated by a comparatively long and narrow neck. The following are the dimensions of the air-bladder in a specimen 102 mm. long without the caudal :—

Length of anterior chamber	...	...	4.5 mm.
" " posterior "	...	...	3.2 "
Greatest diameter of anterior chamber	...	...	3.3 "
" " " posterior "	...	...	1.3 "

The colour has faded in spirit, but even now indistinct longitudinal black bands can be seen on the body and an indistinct black dot on the operculum near its angle.

Type-specimen.—F 8123/1, *Zoological Survey of India (Ind. Mus.)*.

Locality.—From Lahej near Aden, where it is said to be very common. The specimens were presented to the Indian Museum by Dr. W. T. Blanford.

Measurements in millimetres.

	A.	B.	C.
Total length excluding caudal	121	121	98
Length of head	29	28	24.5
Width " "	21	21.5	18
Depth of body	33.5	32	24
Length of snout	17	16	13
Diameter of eye	6	5.5	5.5
Interorbital width	11	11.5	9.5
Height of dorsal fin	27	27.5	22.6
Length of anal "	23	22.5	20
" " pectoral "	28	28	24
" " ventral "	26	26	21
Length of caudal peduncle	24	19	17
Depth " "	16	16.5	14.5
Length of rostral barbels	5	4	4.3
Gape of mouth	12	13.5	10

Playfair¹ in 1870, recorded from Lahej some fish, which he referred to *G. lamta*, on the authority of Günther. He also gave a short description of his specimens. My examples do not agree with his account of these fishes and, therefore, I suppose that in Arabia as in other countries where this genus is found there is probably more than one species. Our Arabian specimens certainly do not belong to *G. lamta*, to which they were originally referred. The new species differs from Playfair's description in the following characters :—

- (i) The number of the longitudinal series of scales between

¹ *Proc. Zool. Soc. London*, pp. 85, 86 (1870).

the lateral line and the ventrals is three and a half in *G. arabica*, while it is four and a half in Playfair's form.

(ii) In *G. arabica* the pectoral terminates about a half of its own length from the root of the ventral, while in Playfair's examples it terminates "at about its own length before root of ventral."

(iii) The proportions in the two species do not agree. *G. arabica* closely resembles *G. stenorhynchus* and *G. gotyla* from India in the character of the snout, which in these three species possesses a proboscis; but whereas in the two Indian species the proboscis is single, in the Arabian species it is provided with two short processes near its base, one on each side. The three species also differ in proportions and number of fin-rays.

Garra sp.

? 1897. *Discognathus* sp.? Nikolsky, *Ann. Mus. Zool. Acad. Petersbourg* II, p. 348.

1910. *Discognathus lamta*, Jenkins, *Rec. Ind. Mus.* V, p. 124.

In this fish the dorsal profile rises from the anterior end of the snout to the origin of the dorsal fin, beyond which it slopes down to the base of the caudal fin. The ventral profile in front of the ventrals is straight and horizontal. The head and body are depressed and the scales on the chest and the middle of the abdomen are poorly developed. To the naked eye, indeed, the surface appears to be absolutely devoid of scales. The length of the head is contained 3·6 in the length of the fish without the caudal fin. The head is almost 1·4 times as long as broad. The eye is almost in the middle of the head or somewhat in the posterior half, its diameter is contained 5 times in the length of the head. It is dorso-lateral in position and is invisible from below. The interorbital space is slightly less than the length of the snout and almost equals the gape of the mouth; it is twice the diameter of the eye. The snout projects considerably beyond the mouth which is provided with a fringed labial fold. The mental disc is well developed. There are eight branched rays in the dorsal and five in the anal. The origin of the dorsal is equidistant from the end of the snout and the base of the caudal fin and is also considerably in advance of that of the ventral. There are two pairs of short barbels. The maxillary barbels are shorter than the diameter of the eye, while the rostral barbels are longer. There are 33 scales along the lateral line and 8 rows between the bases of the dorsal and the ventral fins.

The air-bladder is slightly reduced, otherwise it is of the normal Cyprinid type. The following are its dimensions in a specimen 51·5 mm. in length without the caudal :—

Length of posterior chamber	...	...	9·5 mm.
" " anterior	"	"	5·2 "
Greatest diameter of posterior chamber	...	...	2·0 "
" " anterior	"	"	3·5 "

In spirit the upper surface of the head and body is dusky and the belly is white.

Locality.—Only one specimen from Persian Baluchistan (W. T. Blanford's Persian collection) has been examined. It is immature and the sex cannot be determined.

The species differs from *G. persica*, Berg (1913) in having the upper lip fringed, in having no scales on the belly and in proportions and colouration. In it the eye is situated almost in the centre of the head, while in *G. persica* it is in the posterior half.

***Garra rufus* (Heckel).**

1843. *Discognathus rufus*, Heckel, *Russeger's Reis.* I, p. 1071, pl. 8, fig. 2.

1884. *Discognathus lamta*, Tristram, *Faun. Flor. Palest.*, p. 172, pl. xix, fig. 3.

1913. *Discognathus lamta* var. *rufus*, Annandale, *Journ. As. Soc. Bengal* (n.s.) IX, pp. 36—38, fig. 2.

Through the kindness of Mr. Tate Regan, to whom our best thanks are due, we are now in possession of the original description of Heckel's species. After a careful comparison of Dr. Annandale's Palestine specimens with the description of Heckel's *G. rufus* from Syria, I have not been able to find any specific differences.

In *G. rufus* the air-bladder is well-developed and its length is contained 2·7 times in the total length of the fish without the caudal fin.

***Garra blanfordi* (Boulenger).**

1900. *Discognathus blanfordi*, Boulenger, *Cat. Fresh-w. Fish. Africa* I, p. 249, fig. 263.

While discussing the distribution and relationship of the genus *Discognathus*, Annandale¹ pointed out the possibility that the African species "may be degenerate rather than primitive." He had then no African specimens for examination. I have now dissected a specimen of *G. blanfordi* from Abyssinia in order to see the air-bladder and the weberian ossicles and find the structure of both to be of normal Cyprinid type. The air-bladder is fairly extensive and is not covered by any fibrous coat. The weberian ossicles and the bladder are of the normal Cyprinid type. It is clear, therefore, that *D. blanfordi* is not degenerate in so far as the air-bladder is concerned. The following are the measurements of a specimen 35 mm. in length without the caudal:—

Length of anterior chamber	...	...	5·2 mm.
" " posterior "	...	...	7·5 "
Greatest diameter of anterior chamber	...	...	3·6 "
" " " posterior "	...	...	2·3 "

***Garra adiscus* (Annandale).**

1919. *Discognathus adiscus*, Annandale, *Rec. Ind. Mus.* XVIII, p. 68 pl. x, fig. 2; pl. xi, fig. 1.

1920. *Discognathus adiscus*, Annandale and Hora, *ibid.*, p. 165.

¹ *Rec. Ind. Mus.* XVIII, p. 69 (1919)

Annandale pointed out in the description of the species that it "must be accepted as an extremely primitive representative of *Discognathus*." In another paper in the same volume (p. 165) I concurred in the same view. I have now examined the skeleton and the air-bladder more closely and find some corroborative evidence, but as has already been pointed out it is impossible to express any final opinion on the subject until the Malayan species assigned to *Crossochilus* are examined anatomically.

I have prepared skeletons of the jaws in *Crossochilus latia*, *Cirrhina mrigala* and *Garra adiscus* for comparison and find great similarity as regards their bony structure in *G. adiscus* and *C. mrigala*. Both these differ from *C. latia* in having a longer articular bone and better developed branchiostegal rays. They also differ in the character of the basibranchiostegal bone or urohyal. Correlated with these differences there are others in the air-bladder. Whereas the bladder of *C. mrigala* and *G. adiscus* are of the normal type, in *C. latia* it is somewhat reduced and differs considerably from the normal form, more closely resembling that of some advanced species of *Garra*. The posterior chamber has become cylindrical with an almost uniform thickness throughout, and its walls are also thickened. It is clear, therefore, that *G. adiscus* is more closely allied to *Cirrhina* than it is to *Crossochilus*. In this respect *G. adiscus* agrees with other less modified species of *Garra* I have examined.

The following are the measurements of the bladder in a specimen 58 mm. in length :—

Length of anterior chamber	...	...	...	6.8 mm.
" " posterior "	...	...	...	11 "
Greatest diameter of anterior chamber	...	...	...	4.5 "
" " " posterior "	...	...	...	3.2 "

The systematic position of this species is rather doubtful. I provisionally include it in the genus *Garra*.

***Garra rossicus* (Nikolsky).**

1889. *Discognathus lamta*, Günther, *Trans. Linn. Soc. London* V (2), p. 107.
 ?1897. *Discognathus variabilis*, Nikolsky, *Ann. Mus. Zool. Ac. Sci. St. Petersburg* II, p. 347.
 1899. *Discognathus variabilis*, Nikolsky, *ibid.*, IV, p. 412.
 1900. *Discognathus rossicus*, Nikolsky, *ibid.*, V, p. 239.
 1905. *Discognathus rossicus*. Berg, *Izv. Vost.-sibir.* IV, Vuip. 6, p. 261, pl. iv.
 1906. *Discognathus variabilis*, Regan, *Journ. As. Soc. Bengal* II p. 8.
 1919. *Discognathus phryne*, Annandale, *Rec. Ind. Mus.* XVIII, p. 70, pl. x, fig. 3; pl. xi, fig. 2.
 1920. *Discognathus phryne*, Annandale and Hora, *ibid.*, p. 166.

This species is closely allied to *G. variabilis*, Heck., from which it differs in the following characters :—

(i) The origin of the dorsal fin is considerably nearer the base of the caudal fin than the tip of the snout.

(ii) The minimum height of the dorsal fin is contained more than twice in its maximum height.

(iii). The caudal fin is deeply emarginate.

(iv) The chest and back are naked.

(v) The proportions are different in the two species.

Nikolsky described *G. rossicus* from the specimen which he had previously referred to *G. variabilis*. Annandale and myself in 1920 regarded Nikolsky's *G. variabilis* as a synonym of *G. phryne* but overlooked his later paper (1900) in which the specific name *rossicus* is proposed. I have now carefully compared the descriptions of *D. phryne* and *D. rossicus* and do not think that there is any difference between the two forms. In his Latin description Nikolsky makes no mention of the scales on the chest or on the back; but considering that his specimens were obtained from the same locality whence Annandale described his *G. phryne*, I have no doubt that the two species are identical.

I refer to this species the specimens collected by Aitchison when he was attached to the Afghan Delimitation Commission. These examples are not in good condition for detailed examination; but so far as I have been able to make out the only difference between them and the *G. phryne* from Seistan lies in the structure of the mental disc. In the Afghanistan examples the free borders of the disc are well developed.

I also refer to this species Col. MacMahon's specimens from Seistan and several examples collected by Col. Alcock in the Shila and Lora Rivers, Afghanistan.

This species is fairly common in the hilly country of Baluchistan but is rare in Seistan and Oriental Persia.

The air-bladder, like the other less modified species of *Garra*, is fairly extensive and is of the normal form. In a mature female 55 mm. in total length, the measurements are as follows:—

Length of anterior chamber	...	...	...	6.0	mm.
" " posterior "	...	...	...	11.0	"
Greatest diameter of anterior chamber	...	...	...	5.0	"
" " " posterior "	...	...	...	3.5	"

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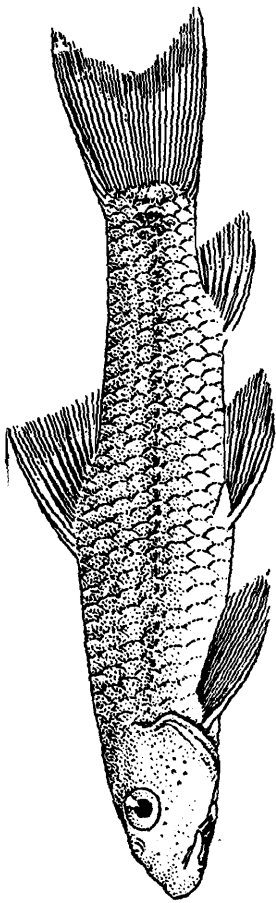
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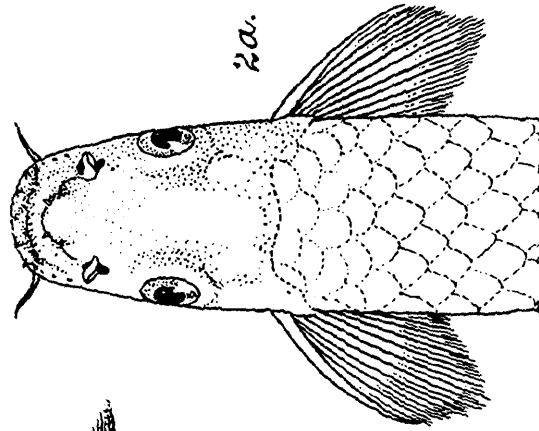
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EXPLANATION OF PLATE XXIV.

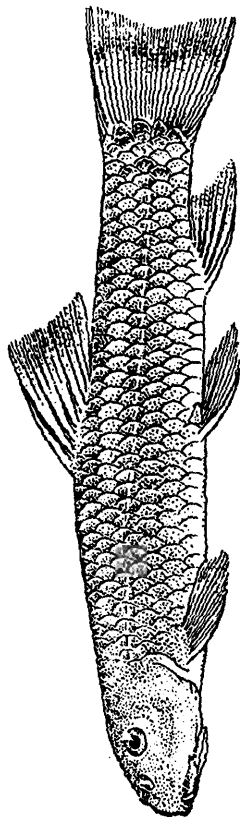
- FIG. 1.—*G. rupeculus* (McClelland). $\times 3$.
,, 2.—*G. lamta* (Ham. Buch.). Female $\times 2$.
,, 2a.—*G. lamta* (Ham. Buch.), upper surface of head showing short, blunt proboscis on the snout in male $\times 3$.
,, 3.—*G. prashadi*, sp. nov. $\times 1\frac{1}{2}$.
,, 4.—*G. nasutus* (McClelland). Nat. size.



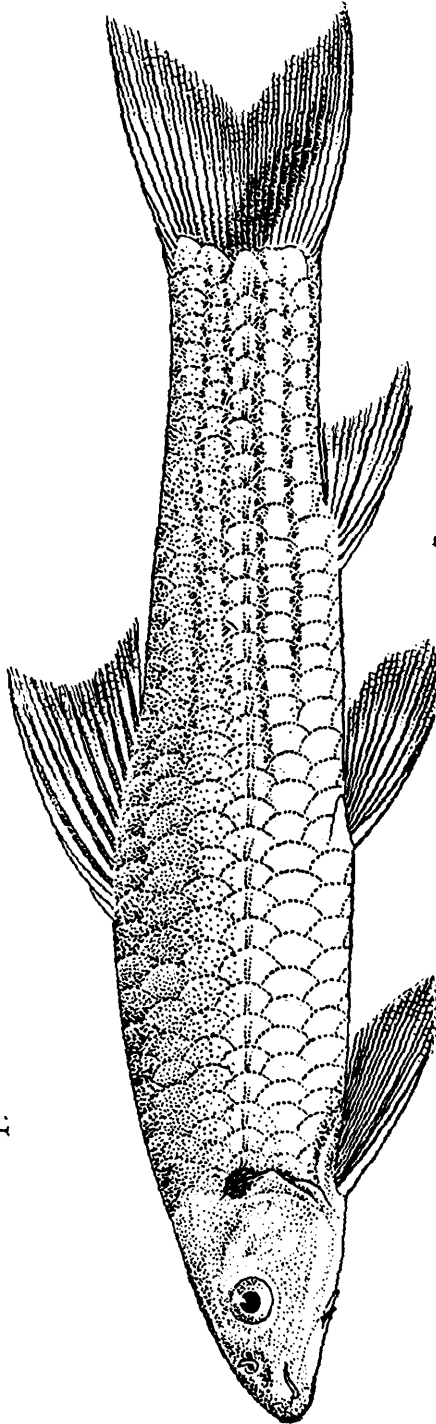
2.



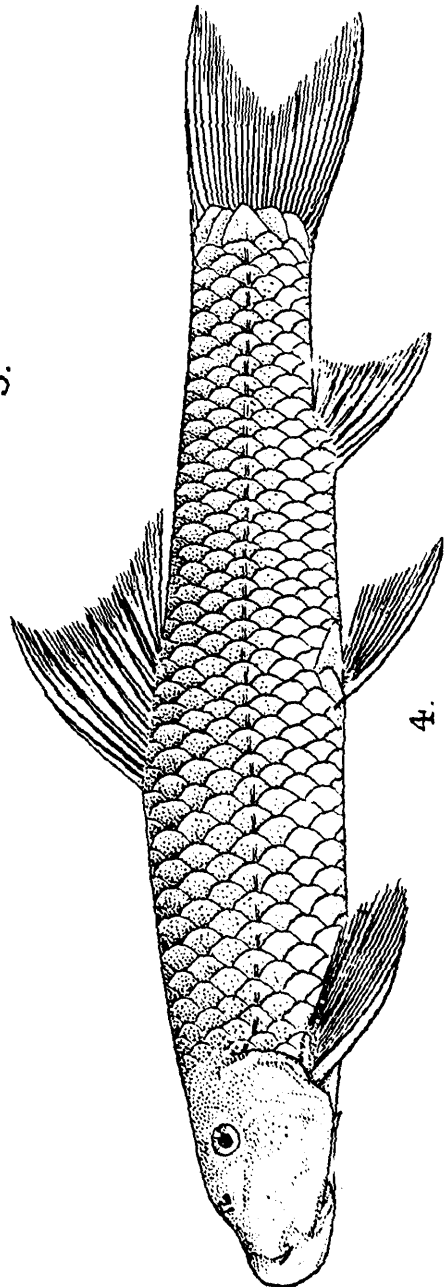
2a.



1.



3.



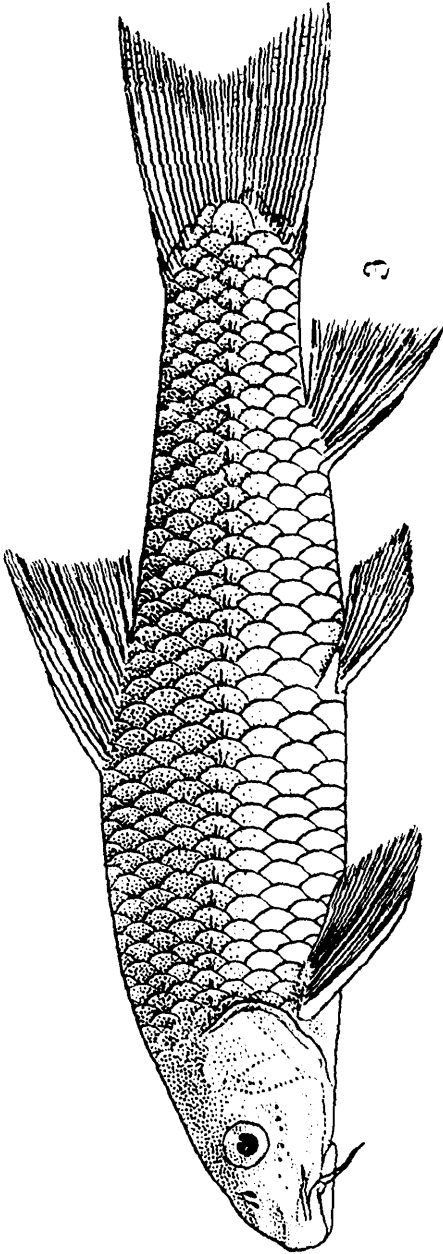
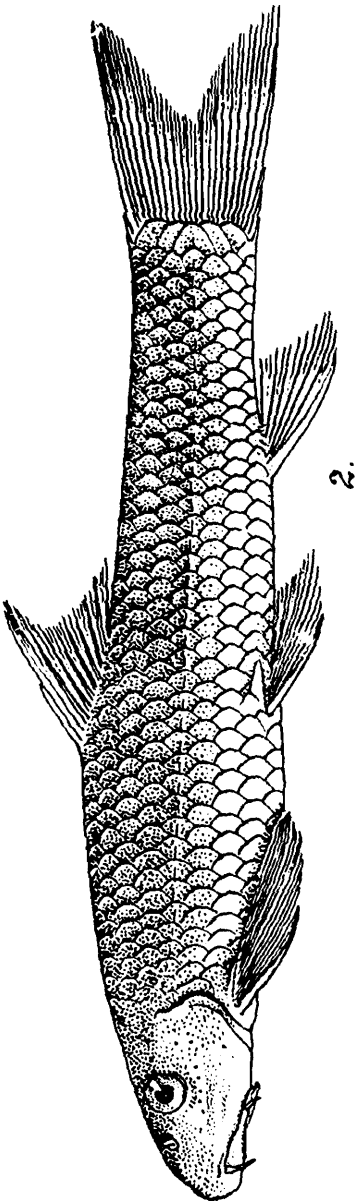
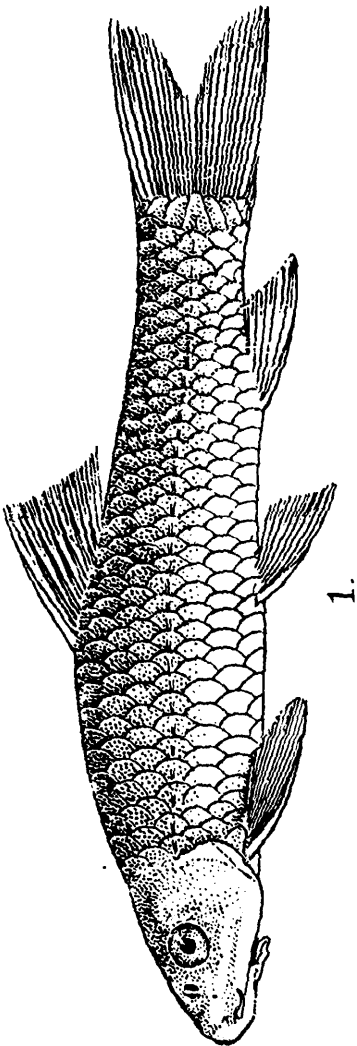
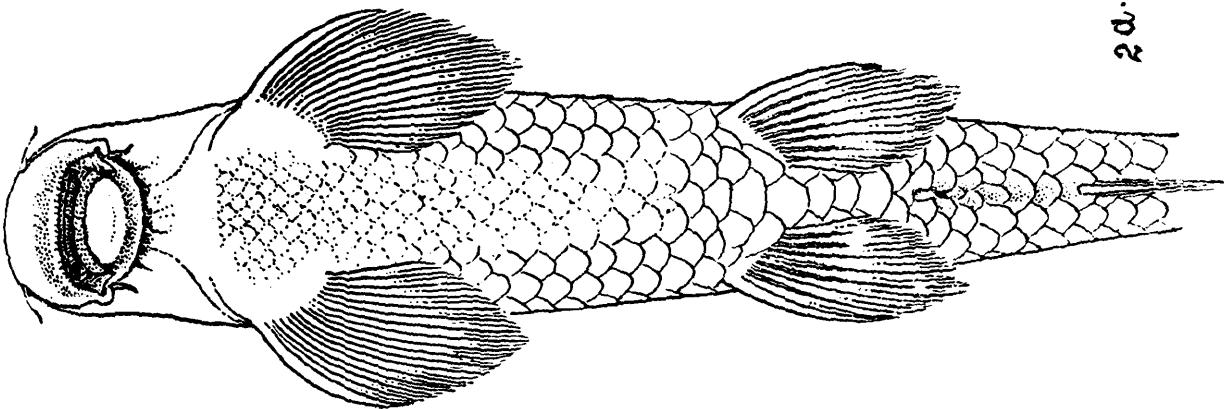
4.

A. Chowdhary del.

INDIAN SPECIES OF GARRA.

EXPLANATION OF PLATE XXV

- FIG. 1.—*G. jenkinsianum*, sp. nov. $\times 1\frac{1}{2}$.
,, 2.—*G. naganensis*, sp. nov. Nat. size.
,, 2a.—*G. naganensis*, sp. nov. Ventral view from tip of
snout to base of anal fin. $\times 1\frac{1}{2}$.
,, 3.—*G. chaulhurii*, sp. nov. $\times 2$.

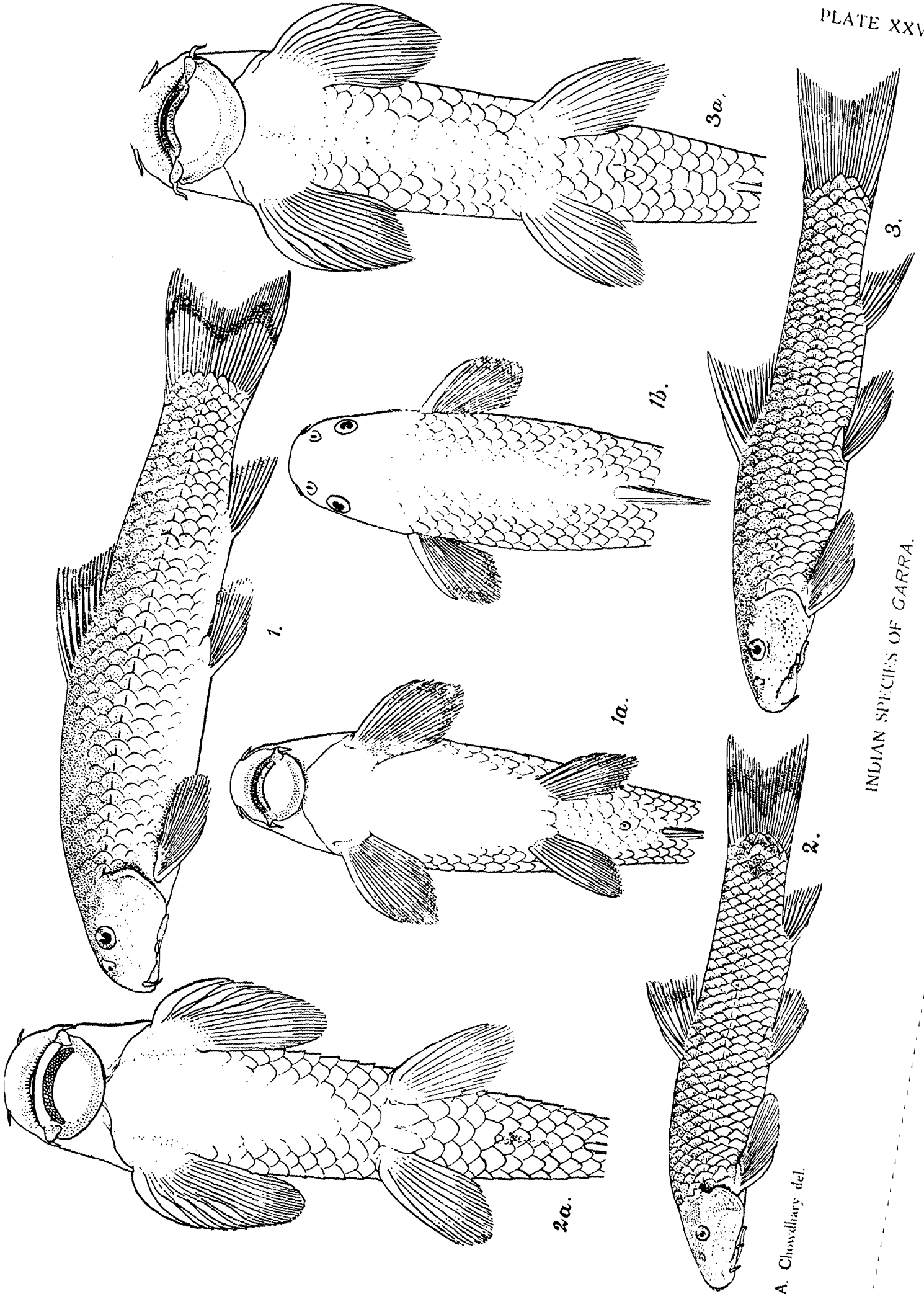


INDIAN SPECIES OF GARRA.

A. Chowdhary del.

EXPLANATION OF PLATE XXVI.

- FIG. 1.—*G. abhoyai*, sp. nov. $\times 1\frac{1}{2}$.
,, 1*a*.—Dorsal surface of same in front of dorsal fin $\times 1\frac{1}{2}$.
,, 1*b*.—Ventral surface of same in front of anal fin. $\times 1\frac{1}{2}$.
,, 2.—*G. lissorhynchus* (McClelland). $\times 1\frac{1}{2}$.
,, 2*a*.—Ventral surface of same in front of anal fin. $\times 2\frac{1}{2}$.
,, 3.—*G. kempi*, sp. nov. Nat. size.
,, 3*a*.—Ventral surface of same in front of anal fin. $\times 1\frac{1}{2}$.



INDIAN SPECIES OF *GARRA*.

A. Chowdhury del.

XXX. NOTES ON SOME LEECHES IN THE COLLECTION OF THE INDIAN MUSEUM.

By TOKIO KABURAKI, *Research Student, Imperial University,
Tokyo.*

(From the Zoological Laboratory, the Museums, Cambridge.)

The present account is the result of the examination of a large collection of leeches belonging to the Indian Museum, which was placed by Dr. N. Annandale in my hands for identification. The material was originally intended for use, in conjunction with Mr. W. A. Harding, in the preparation of a volume in the "Fauna of British India" series on the said group; but, as Mr. Harding is unable to continue the work, it has become necessary for me to take the whole responsibility upon myself, and also to confine myself to a rough investigation, owing to the unavoidable pressure of many other studies during my stay in foreign countries. It is hoped, therefore, that at least some of the species will be subjected to full anatomical investigation in the future.

Most workers on the systematic side complain of the enormous difficulty of determining the species or even the genera of leeches owing to the fact that the descriptions of many of the known species are based solely upon external characters without any regard to internal structure. This seems to me to be more apparent than real. It is, however, necessary, as has been mentioned by Oka (1917), to submit the group to a thorough revision in reference to internal characters. In the present paper, however, I have adopted the generic designations in current use, leaving the problem to those who may have occasion to study personally a large number of forms and especially to re-examine the species previously recorded.

In the leech, as is well known, the large number of rings found on the body resolve themselves into a series of regularly recurring groups corresponding to the successive somites. It has long been recognised that we have to account for twenty-seven somites in the body excluding the posterior sucker, the number of the somites corresponding with that of the ganglia in the central nervous system. Towards the ends of the body the number of rings in a somite becomes smaller, and at the extremities one or more somites are found represented by only one ring.

Much debate has arisen as to the determination of somite-limits. In this communication, however, I have intentionally abstained from taking part in such a discussion and have adopted the neuromeric standard of somite-limits advocated by Moore

(1900), Castle (1906) and some others. The sensory ring may be regarded as corresponding to the middle ring of each typical somite, lodging a ganglionic mass of the ventral chain and in several cases possessing the "metameric sensillae," which are often rendered conspicuous by association with special colour markings and by elevation upon more or less prominent papillae. Of course it is sometimes extremely difficult or nearly impossible to determine the somites by this means, because of the indistinctness or the entire absence of papillae and colour markings. Here, however, I insist upon this conception: the Chinese species *Myxobdella annandalei*, Oka (1917), seems to indicate that the neuromeric standard of somite-limits is true. In this species the body, though wholly devoid of segmental papillae, is divided by deep furrows into distinctly bounded somites, each being subdivided into rings by much shallower ones. The ganglionic mass occupies a position in the middle of each typical somite.

Here I deem it my duty to express my best thanks to Dr. N. Annandale for the privilege of allowing me to examine this large collection of leeches, and to Professor J. S. Gardiner for providing me with accommodation in his laboratory. My thanks are also due to Mr. W. A. Harding for giving and lending me some literature.

The following is a list of the species dealt with in the present paper:—

Sub-order RHYNCHOBDELLAE.

Family ICHTHYOBDELLIDAE.

1. *Ozobranchus jantseanus*, Oka.
2. *Ozobranchus papillatus*, sp. nov.
3. *Pterobdella amara*, Kaburaki.
4. *Cystobranchus anoculatus*, sp. nov.
5. *Piscicola olivacea*, Harding.
6. *Piscicola caeca*, Kaburaki.

Family GLOSSOSIPHONIDAE.

7. *Hemiclepsis marginata* (O. F. Müller).
8. *Glossosiphonia weberi*, R. Blanchard.
9. *Glossosiphonia lata*, Oka.
10. *Glossosiphonia ceylanica*, Harding.
11. *Glossosiphonia reticulata*, sp. nov.
12. *Placobdella emydae*, Harding.
13. ? *Placobdella gracilis* (R. Blanchard).

Sub-order ARHYNCHOBDELLAE.

Family HERPOBDELLIDAE.

14. *Herpobdella lineata* (O. F. Müller).
15. *Herpobdella hexoculata*, sp. nov.
16. *Herpobdelloidea lateroculata*, gen. et sp. nov.

17. *Nematobdella indica*, gen. et sp. nov.
18. *Foraminobdella heptamerata*, gen. et sp. nov.
19. *Scaptobdella horsti*, R. Blanchard.

Family GNATHOBDELLIDAE.

20. *Whitmania laevis* (Baird).
21. *Limnatis nilotica* (Savigny).
22. *Limnatis granulosa* (Savigny).
23. *Haemopsis sanguisuga* (Linnaeus).
24. *Haemopsis birmanica*, R. Blanchard.
25. *Haemopsis concolor*, sp. nov.
26. *Myxobdella annandalei*, Oka.
27. *Haemadipsa zeylanica* (Moquin-Tandon).

Sub-order RHYNCHOBDELLAE.

Family ICHTHYOBDELLIDAE.

Genus *Ozobranchus*, de Quatrefages.

1. *Ozobranchus jantseanus*, Oka, 1912.

Numerous specimens of a species identical with Oka's *Ozobranchus jantseanus* from China were obtained by Dr. B. L. Chaudhuri from a *Kachuga donghoka* in the Zoological Gardens of Calcutta, which was originally brought from Oodhua near Rajmahal.

The body is depressed and formed of two distinct regions, a short narrow neck and a long large abdomen, the former being partly invaginated into the abdominal region, as is the case with *Branchellion*. The abdomen is provided with eleven pairs of digitate branchiae, of which the anterior are much larger and more branched than the posterior. The anterior sucker is very small and not distinct from the neck, while the posterior represents a large cupuliform disc with a diameter about as broad as the abdominal part of the body. The large examples are about 25 mm. in length, without the posterior sucker, and 7 mm. across at the middle of the abdomen.

The complete somite is formed of two rings of different size, the first ring being enlarged and the second narrower. In the abdominal, but not in the neck region, each ring, as stated by Oka (1917), is in some cases marked on the dorsal surface with a transverse row of papillae beset with more than one sharp point.

In the preserved specimens the body, though colourless in most instances, is sometimes of a brownish colour, without any trace of markings.

A pair of eyes lie slightly behind the level of the mouth which opens near the centre of the anterior sucker.

The male and female genital organs open in common at the base of the neck, where the latter merges into the abdomen.

The anus is located on the dorsal surface between the last two somites of the body.

2. *Ozobranchus papillatus*, sp. nov.

The collection contains some examples which appear to represent a new species, found by Mr. E. A. D'Abreu on the leg of *Kachuga tectum* at Nerbudda, Nagpur.

The species closely resembles the preceding, in its external features there being distinguished two distinct regions, the neck and the abdomen, with the eleven pairs of digitate branchiae. The typical somite consists of two rings of nearly similar breadth, each ring in the abdomen being provided with conical papillae on the dorsal surface. The papillae are of small size and present a single sharp end, differing from *O. jantseanus*. The colour of the body is grey and exhibits no trace of markings, except a darker shade in the anterior region of the abdomen. All the specimens are strongly contracted and are about 7 mm. long by 4 mm. broad at the middle of the abdomen. The most conspicuous character which distinguishes this species from *O. jantseanus* is the absence of any trace of eye-like organs.

Genus *Pterobdella*, Kaburaki.3. *Pterobdella amara*, Kaburaki, 1921.

In a recent paper ¹ I placed on record in some detail this interesting species which was found in the Chilka Lake, adhering to the mouth of *Hypolophus sephen* and *Trygon uarnak*. The trunk is of a peculiar shape, being divided into three distinct regions, of which the anterior two each carry a pair of conspicuous lateral *fin-like bodies*. *The visual organs are entirely absent.*

Genus *Cystobranchus*, Diesing.4. *Cystobranchus anoculatus*, sp. nov.

In the collection there are three specimens which appear to represent an interesting member of the genus *Cystobranchus*, their locality being unknown. Hitherto recognised as belonging to this genus are four species,—*C. respirans* (Troschel), *C. fasciatus* (Kollar), *C. vividus* Verrill and *C. mammillatus* (Malm),—all ectoparasitic on various freshwater fish such as *Cyprinus carpio*, *Barbus fluviatilis*, *Thymallus vulgaris*, *Rhodens amarus*, *Trutta fario*, etc. Of these species *C. mammillatus* seems to be by far the most closely related to the species here described.

In shape this leech conforms to the typical *Cystobranchus*-outline, with the short narrow neck, distinctly separated from the abdomen, which is elongate, wide, of a nearly uniform breadth for the greater part of its length and is provided, as in all species of the genus, with eleven pairs of pulsating vesicles. The suckers are large and are centrally attached, the anterior sucker being about one-third as wide as the posterior. In no case have I been

¹ See Kaburaki, *Mem. Ind. Mus.* V p. 668, figs. 3, 4.

able to observe any trace of the dark spots on the posterior sucker, which are to be observed in *C. respirans*. The body is about 21 mm. long by 3.5 mm. across in the middle of the abdominal region.

The complete somite is formed of seven rings. In the first eleven somites of the abdominal region each somite carries a pair of the pulsating vesicles which, in diastole, arch up the skin, usually extending over rings 2 to 5.

The leech is wholly devoid of any trace of eyes, as is the case with *C. mammillatus*.

The body in the preserved state is of a dirty brown colour, being marked with a darker shade in the region of the genital openings, just anterior to the abdomen.

The mouth lies near the centre of the anterior sucker and leads into the pharyngeal sheath with the pharynx, which is cylindrical in shape and extends over about three somites, vii-ix. Widely distributed on either side of the pharynx are numerous salivary glands, which make their way to the base of the pharynx. The crop represents a distensible part of the digestive tract and is provided with seven pairs of subdivided lateral diverticula which come off metamerically in each of the first seven somites of the abdomen. The last pair are reflected posteriorly and extend into somite xxii, giving off a secondary, outwardly directed diverticulum in each somite and appearing to fuse together metamerically, as stated by Johansson. The stomach possesses four pairs of nearly pear-shaped lateral pouches, a pair in each of somites xix-xxii. The intestine is in the form of a more or less wide canal, passing to the dorsally situated anus between somites xxvi and xxvii. The walls of the stomach and intestine are richly supplied with blood vessels.

The vascular system seems to be similarly constructed to that of other Ichthyobdellids, there being the dorsal and ventral vessels, which lie respectively in the dorsal and ventral sinuses of the coelome. These sinuses give off metamerically arranged transverse branches and communicate with the lateral vesicles, thus forming a complete circle.

The male genital orifice, though I could not determine it with certainty, appears to lie between the last two rings of somite xi, the female orifice is seven rings behind the male, that is in somite xii.

The six pairs of testes lie anterior to each of the first six pairs of lateral diverticula of the crop. Anteriorly the vasa deferentia on each side assume the character of a wide tortuous passage, and after uniting to form the "prostate," open to the exterior by the male orifice. The female organs appear to be similar in structure to those of other Ichthyobdellids.

Genus *Piscicola*, Malm.

5. *Piscicola olivacea*, Harding, 1920.

This species, as mentioned in my recent paper (*loc. cit.*), is fairly common in the Chilka Lake and occurs usually attached to

the body, or to the palate within the mouth, of fish such as *Hypolophus sephen*, *Tetrodon reticularis* and *Dorosoma indica*. In shape this leech conforms to the typical *Piscicola*-outline, with the circular suckers, of which the anterior is rather less than half the size of the posterior sucker. The eleven pairs of pulsating vesicles are conspicuous, especially in the living forms. Situated dorsally on the anterior sucker are two pairs of eyes, as in *P. geometra*, Linn.

6. *Piscicola caeca*, Kaburaki, 1921.

This leech inhabits the Chilka Lake and was found attached to the jaw of *Hypolophus sephen*. It is closely allied to the preceding species, but may be easily distinguished from it by the absence of eyes.

Family GLOSSOSIPHONIDAE.

Genus *Hemiclepsis*, Vejdovsky.

7. *Hemiclepsis marginata* (O. F. Müller), 1774.

Hirudo marginata (O. F. Müller), 1774.

Glossosiphonia marginata, Moquin-Tandon, 1846.

Some examples of a species identical with *Hemiclepsis marginata* were collected by Dr. F. H. Gravely at Bagra in Hoshangabad District and also by Dr. T. Southwell from a species of *Lamellidens* at Bhandardaha Beel in the Murshidabad District. The species is one of wide distribution, being known to occur throughout the greater part of Europe, China and Japan.

The body in the preserved condition is elongate-lanceolate, the head being separated from the trunk by a slight neck-like narrowing. The dorsal surface is marked with very weakly developed papillae. Centrally attached is the posterior sucker, which is of a nearly circular shape. The largest specimens are about 7 mm. long by 4 mm. across at the middle of the body.

Counted on the dorsal surface are seventy-two rings, which appear to be grouped as follows: somites i and xxvii are unianulate, ii, iii, iv, xxv and xxvi biannulate; the twenty somites v-xxiv are complete with three rings.

The two pairs of eyes lie in rings 3 and 4 respectively, the first pair being much smaller than the second.

The body is of a yellowish colour in spirit and is marked with pigment-patches which occupy a definite position on the rings, so that those on successive somites form seven longitudinal rows, three in each half of the body and one median in position. The paired rows may be designated as marginal, intermediate and paramedian. The patches forming the median and marginal rows fall on the second ring of each typical somite, while those composing the paramedian and intermediate rows occur on the first ring. The median row is much more conspicuous than any of the others.

The mouth is situated near the centre of the anterior sucker. Extending over about three somites, vii-ix, is the pharynx, which is of a cylindrical shape. The crop is provided with some ten pairs of subdivided lateral diverticula, one pair in each of somites x-xix. The last pair are reflected posteriorly, giving off four secondary, outwardly directed diverticula. The stomach bears four pairs of lateral pouches which lie within the three somites xx-xxii. Opening on the dorsal surface is the anus, which occurs between the last two somites.

The male genital orifice, though I could not find it out definitely, seems to lie between somites xi and xii, and the female orifice is two rings behind the male, that is between the second and third rings of somite xii.

Genus *Glossosiphonia*, Johnson.

8. *Glossosiphonia weberi*, R. Blanchard, 1897.

(Text-fig. 1.)

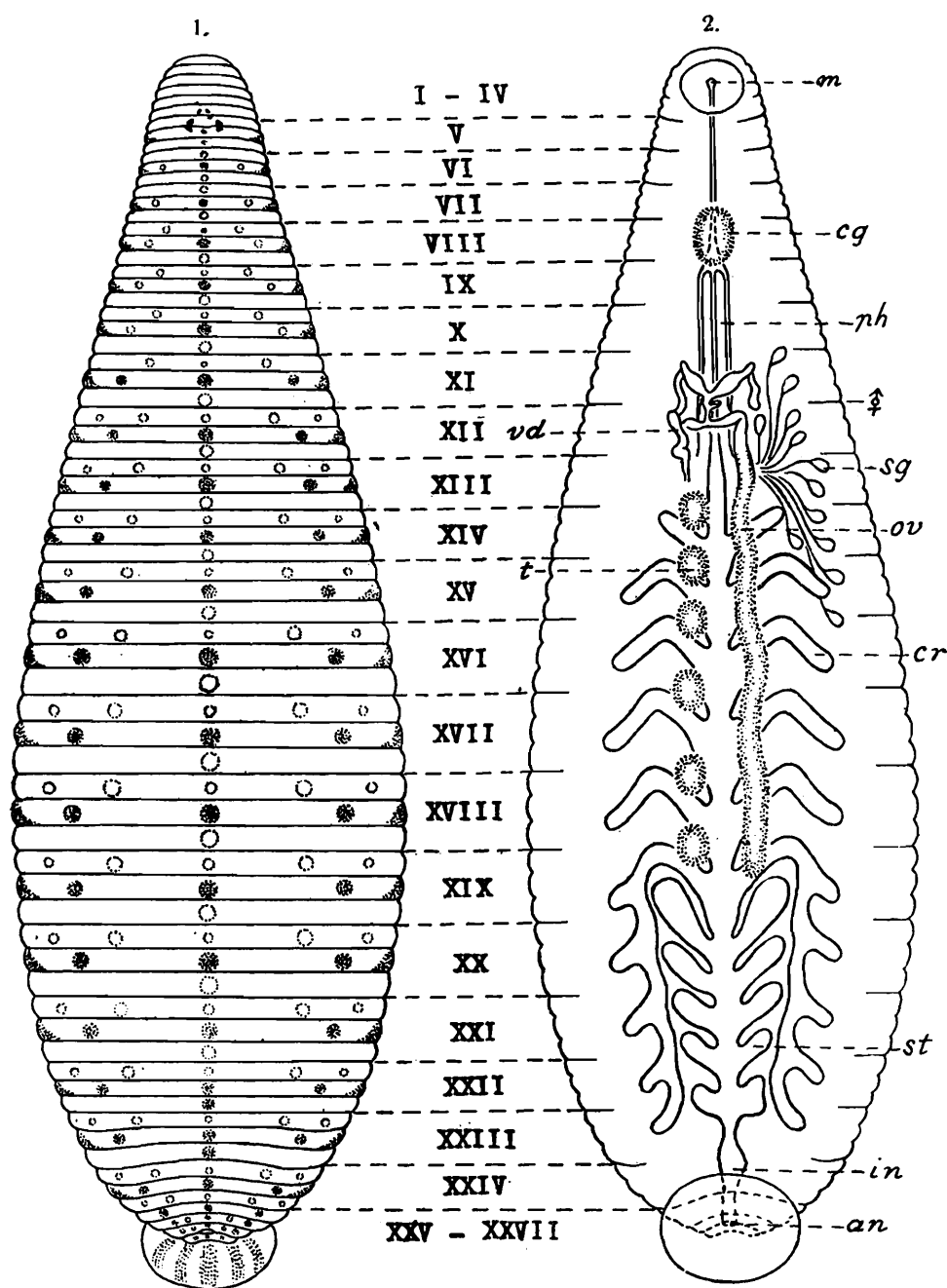
The material was found at the north end of Lake Loktak, Manipur, adhering to the body of *Vivipara oxytropis* (Benson).

On examination, the species, though exhibiting a small difference in the position of the genital orifice, proves to be identical with Blanchard's *Glossosiphonia weberi* from Sumatra described by that author. *Gl. weberi* is very closely related to *Gl. heteroclita* (Linn.) which is of wide distribution in Europe and America, but it is distinguishable from it by the possession of numerous well-developed papillae on the dorsal surface.

The body is generally of small size, in a full grown condition being 8 mm. long, exclusive of the posterior sucker, by 4 mm. across at the middle. In the preserved state the body as seen in dorsal aspect is ovate-elliptical in form, broadest slightly behind the middle, and thence tapering more gradually to the anterior than to the posterior end. The dorsal surface is much arched and quite rough all over, owing to the presence of numerous well-developed conical papillae, while the ventral surface is nearly flat and entirely smooth. The anterior sucker, as in all species of *Glossosiphonia*, lies on the ventral side of the head, within the limits of rings 1-5. The mouth is situated slightly anterior to the eyes, well forward in the anterior half of the said sucker. The posterior sucker is sometimes ventral in position and of a small ovate or circular shape, the diameter being about 1 mm.

The external rings are rather conspicuous; counting dorsally, so far as my observation goes, there are seventy in front of the posterior sucker, of which the preocular rings are in most cases five in number, and rings 5 and 6 coalesce on the ventral surface, forming the posterior margin of the anterior sucker. Blanchard speaks of there being four preocular rings in the Sumatran form, but the number, as Castle (1905a) has pointed out, is not constant in the case of *Gl. heteroclita*, and no doubt varies to some extent in

Gl. weberi. The composition of the somites is practically the same in this species as in *Gl. heteroclita*. There are twenty-seven somites, of which somites i, ii, xxvi and xxvii are uniannulate; iii, iv and xxv biannulate; the twenty somites are complete, each consisting of three rings.



TEXT-FIG. 1.—*Glossosiphonia weberi*, R. Blanchard.

1. Diagram showing the annulation and external features of the dorsal surface.
2. Diagrammatic representation of the organization, as seen from the dorsal side;
an., anus; *c.g.*, cephalic ganglionic mass; *cr.*, crop; *in.*, intestine; *m.*, mouth;
ov., ovary; *ph.*, pharynx; *s.g.*, salivary gland; *st.*, stomach; *t.*, testis; *v.d.*, vas
 deferens.

The three pairs of eyes are arranged so as to form three groups. The eyes composing the anterior and smallest pair are closely approximated in ring 6, while those forming the second and third pairs are wider apart, occurring in rings 7 and 8

respectively, and are closely apposed on each side. The first two pairs are directed obliquely forwards, the last pair obliquely backwards; all are turned away from the median plane.

Dorsally the rings are marked, as stated above, by conical papillae, which are of various size, and form a transverse row of about 11-17 on every ring. In each transverse row the papillae are arranged, as a rule, symmetrically, some being of larger size and occupying a definite position on every ring, so that those on successive somites form seven longitudinal rows, three in each half of the body and one median in position, as is shown in text-fig. 1. The paired rows may be designated as paramedian, intermediate, and paramarginal. The paramedian rows of non-pigmented papillae are usually constant in occurrence with the intermediate; they fall on the first ring of each somite. The intermediate rows occur upon the second ring of each somite, and usually contain pigment. The papillae composing a median row exist on every ring, though those on the first of each somite are often inconspicuous. The paramarginal rows are less well-developed than any of the others, occurring on the first ring of each somite. This regularity of arrangement loses itself as it proceeds towards both ends of the body.

The body presents a whitish colour in spirit, marked with five longitudinal rows of dark-brown or black pigment-patches which are arranged metamerically extending backwards almost throughout from somite v. These patches mark most often the middle ring of each somite in the position of the papillae forming the median and intermediate rows, as well as at the lateral edge where the dorsal surface passes round to the ventral. On some occasions the median row is seen, without being interrupted, as a continuous stripe. On the posterior sucker we find pigment-patches arranged in some five radial stripes, which correspond to the median, intermediate and marginal rows mentioned. In no case have I been able to observe any trace of special sensory spots.

The specimens had not been preserved in a state fit for the purpose of minute examination. The mouth situated anterior to the middle of the anterior sucker leads into the pharyngeal sheath which extends posteriorly into about somite xii. In it lies the pharynx which is of a cylindrical shape, terminating conically at the free end. At the base the pharynx is furnished from both sides with the ducts of the salivary glands scattered through as many as eight somites, usually somites x-xvii. Posteriorly the pharynx gives rise to the oesophagus, which is a tubular passage opening into the crop, and much longer than that of *Gl. heteroclita*. The wall of the oesophagus is composed of columnar epithelial cells closely set, surrounded by circular muscles. The crop is provided with six pairs of lateral diverticula, one pair in each of somites xiv-xix. In these diverticula there cannot be demonstrated such a tendency to subdivide into two at the tip, as is seen in *Gl. heteroclita*, except in the last pair which extend backwards into somite xxiii and gives off about five secondary, outwardly

directed diverticula, coming off metamerically in somites xix-xxiii. The crop presents a very thin wall and was found to be filled with a dense coagulum. Opening from the crop in somite xix is a short tube leading directly into the stomach which is provided with four pairs of lateral pouches, lying within somites xix-xxii. In structural respects this differs from the crop, possessing its wall which is made up of closely apposed, columnar epithelial cells, surrounded by two sets of muscular fibres, circular and longitudinal. Posteriorly the stomach is continuous with the intestine, which in its course is divided into two chambers by a constriction and finally opens on the dorsal surface between rings 69 and 70.

The vascular and coelomic systems, so far as my observation goes, seem to be constructed on the same plan as in most of the *Glossosiphonids*.

There are some seventeen pairs of nephridia, the ducts of which lie in the lateral parts of the body, forming a convolution in the central portion. The duct opens ventrally on the middle ring of a somite, somewhat nearer the margin than the median line.

The cephalic ganglionic mass lies for the most part in somite viii, consisting, as usual, of the fused ganglia of the first six somites. The arrangement of its ganglionis capsules is the same as that found in *Gl. heteroclita*, though the most ventral and posterior capsule of neuromere i in the present species exhibits no horn-like process extending backwards laterally into contact with the lateral capsules of neuromere iii. Between the cephalic and acetabular ganglionic masses there exist ventrally twenty-one distinct ganglia, which are metamerically arranged and joined by paired connectives. The usual position of the ganglion is in the middle ring of each somite. Towards either end of the body, however, there can be found a slight centripetal displacement of the ganglia, as is seen in many leeches.

The genital organs agree in the main with *Gl. heteroclita*, opening by a common aperture which at a glance seems to lie in the middle of the ring as has been stated by Blanchard. A closer examination, however, has revealed that it is situated between somites xi and xii. It may be considered probable that Blanchard was mistaken, as in the case of *Gl. heteroclita*, in determining the position of the opening.

The male elements consist of six pairs of follicular testes situated intermetamerically on both sides of the median line in somites xiii/xiv-xviii/xix. They are connected on each side by short vasa efferentia with the vas deferens, which proceeds forwards, pursuing a tortuous course, and then dilates into a thick-walled tube, the "prostate." Its entire course could not be definitely made out. About the region of somite xi the prostate on each side makes an abrupt turn downwards and inwards, uniting into a short common duct, which soon opens to the exterior by the common genital aperture from the front.

The female elements are composed of a pair of simple dilated sacs lying ventrally on both sides of the crop and extending almost throughout its whole length. Before opening out by the common aperture from behind, the sac unites with its fellow of the opposite side to form a very short single duct.

9. *Glossosiphonia lata*, Oka, 1910.

Only one example, which appears to be identical with this species, was collected by Professor N. Gist Gee at Soochow, China.

The body is ovate-elliptical, of a firm consistency and presents dorsally a roughened surface owing to the occurrence of papillae. The posterior sucker is a small circular disc, its diameter being about 1 mm. The specimen is 11 mm. in length and 5 mm. in width at the middle of the body.

On the dorsal surface there are seventy-two rings, of which the preocular number seven. These rings, though I could not definitely make them out, appear to resolve themselves into a series of somites somewhat as follows: somites i, xxvi and xxvii are uniannulate; ii, iii, and xxv biannulate; and twenty-one somites complete with three rings.

The three pairs of eyes are similar in their arrangement to those found in the preceding species. The first and smallest pair are approximated in ring 8, while the second and third pairs are wider apart, lying in rings 9 and 10 respectively.

The dorsal surface is marked all over with numerous well-developed papillae which are of various sizes. The larger papillae on successive somites are arranged symmetrically, so as to form seven longitudinal rows, as is seen in *Gl. weberi*. Medially situated on the first and second rings of each typical somite are the papillae which form the median row. The papillae forming the paramedian rows fall on the first ring of each somite in association with those of the paramarginal, which are less developed and partly inconspicuous; while those composing the intermediate rows are situated on the second ring.

In the preserved state the body is of a dark olive colour, marked on the dorsal surface with nine dark brown longitudinal stripes, one median in position and four in each half of the body. Of these four lateral stripes two lie between the median and paramedian rows of papillae, and the other two run just inside the intermediate and paramarginal rows respectively. Besides these an olive-like brown patch marks the middle ring of each somite at the lateral edge of the body. On the ventral surface are also found some interrupted longitudinal stripes which present no regular arrangement.

The crop is provided with six pairs of distally subdivided lateral diverticula, of which the last pair are reflected posteriorly and give off four outwardly directed secondary diverticula. The stomach gives rise, as is usual, to four pairs of pouches. The anus

opens on the dorsal surface between the last two rings of the body.

The male genital orifice is situated between somites xi and xii, and the female orifice appears to open on the first ring of somite xii. There are six pairs of testes, which are each placed in front of the lateral diverticula of the crop.

As is evident from the above, the present species is closely allied to the preceding, *Gl. weberi*; it is distinguished chiefly by the different arrangement of the pigment pattern.

10. *Glossosiphonia ceylanica*, Harding, 1909.

This species is not peculiar to Ceylon, as some examples which I have examined were found in the neighbourhood of Lake Chilka and at Rawalpindi. A full account has been given in my recent paper (*loc. cit.*).

11. *Glossosiphonia reticulata*, sp. nov.

(Text-fig. 2.)

A single individual only, which seems to represent a new species, was collected by Dr. B. Prashad at Jullundur, it having been found attached to the mantle of a species of *Lamellidens*.

The body in the preserved state is slender and broadest at the posterior region, from which it tapers gradually towards the anterior end. The head is marked off from the trunk by a slight neck-like narrowing. The dorsal surface presents a roughened appearance due to the presence of papillae of various sizes, of which the larger ones are arranged so as to form three longitudinal rows, one median and two lateral. The posterior sucker is of a circular shape and is almost centrally attached. The specimen is 10 mm. in length, exclusive of the posterior sucker, by 2 mm. across at the broadest part of the body.

The body appears to comprise in all seventy-two rings, which are grouped somewhat as follows: somites i and ii are uniannulate; iii, iv, xxv, xxvi and xxvii biannulate, and the twenty somites v-xxiv complete with three rings. The papillae occur on almost all of the rings.

There are two pairs of eyes, of which the first and smaller pair lie in ring 4, the second and larger in ring 5.

The preserved specimen is of an olive grey colour due to irregular pigment present all over in reticular distribution as well as to the contents of the crop.

The mouth opens in front of the centre of the anterior sucker. The pharynx represents a long cylindrical tube, beginning just behind the cephalic ganglionic mass situated in somite vii and extending behind into somite x. At the base it is supplied with numerous ducts of the salivary glands which are widely distributed in the anterior region. The crop is a distensible part of the digestive tract and is provided with seven pairs of subdivided diverti-

cula, which occur metamerically in each of somites xiii-xix. The last pair are reflected posteriorly and extend into somite xxiii, sending out four lateral pouches in each of somites xix-xxii. The stomach bears four pairs of lateral pouches and posteriorly joins the wide intestine which opens dorsally between the last two somites.

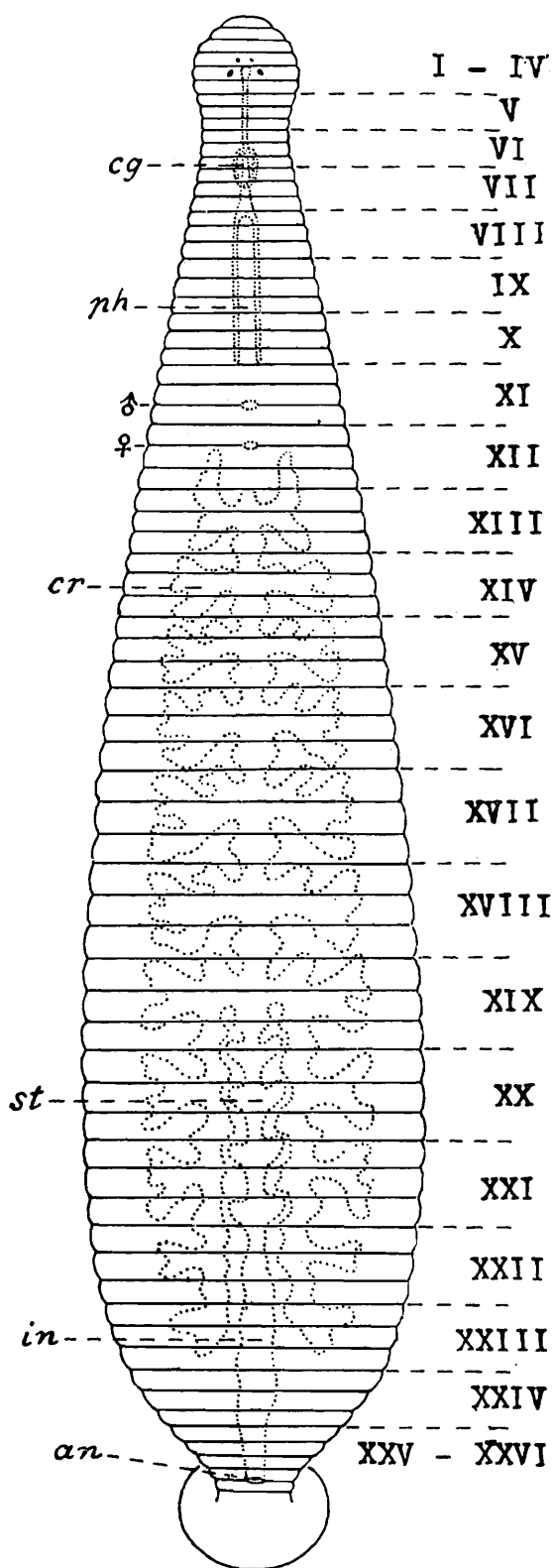
The male genital orifice is placed between somites xi and xii; the female orifice lies two rings behind the male, that is, between the second and third rings of somite xii.

The present species seems to be allied to *Gl. smaragdina*, Oka, rather than to *Gl. paludosa*, Carena, but may be distinguished from them chiefly by the different arrangement of eyes as well as in the possession of well-developed pigment all over the surface.

Genus *Placobdella*, R.
Blanchard.

12. *Placobdella emydae*,
Harding, 1921.

The collection contains a few individuals identical with Harding's *Placobdella emydae*, described in detail by that author from Lake Chilka and elsewhere. The material was collected by Dr. F. H. Gravely at Hoshangabad, Central Provinces, and at an elevation of about 2000 ft. in Taloshi, Koyna Valley, in the Satara District. An example



TEXT-FIG. 2.—*Glossosiphonia reticulata*, sp. nov.

Diagram showing the annulation and some internal features: dorsal aspect. Index letters as in text-fig. 1.

found with *Limnatis granulosa* in Burma seems to be identical with the present species. This leech, according to Harding, is fairly common in India and is usually to be found attached to the mud-turtle.

The body is flattened and lanceolate, presenting a head region which is separated from the trunk by a slight neck-like narrowing. The dorsal surface exhibits a roughened appearance due to the presence on each ring of numerous papillae, which are of various size, the larger ones forming some five longitudinal rows, one median in position and two lateral in each half of the body. The anterior sucker lies on the ventral side of the head, within the limits of rings 1-6, the mouth opening near the anterior lip. The posterior sucker is centrally attached and of a small circular shape. The large specimen is about 8 mm. long by 3 mm. across at the hind part of the body.

The colour in spirit is grey or pale olive brown without any trace of markings.

On the dorsal surface seventy-one rings are counted in front of the posterior sucker. Somites i, ii and xxvii, are uniannulate; iii, iv, xxv and xxvi biannulate; the twenty somites, v-xxiv, are complete with three rings.

A pair of eyes is generally placed in ring 3, but may occasionally be shifted behind so as to extend over ring 4.

The crop is provided with seven pairs of lateral diverticula, a pair in each of somites xiii-xix, which are sometimes subdivided distally. The last pair are, as usual, reflected posteriorly and extend into somite xxii, giving off a secondary, outwardly directed diverticulum in each of the four somites xix-xxii. The anus is situated on the dorsal surface between the last two somites.

The male and female genital orifices are separated by two rings, the male orifice being situated between somites xi and xii, the female between the second and third rings of somite xii.

In one case, attached to the ventral surface of the parent, were found numerous larvae which were about 1 mm. in length.

13. ? *Placobdella gracilis* (R. Blanchard), 1897.

Helobdella gracilis, R. Blanchard, 1897.

The collection contained a single specimen, which was found at Nandi, Mysore State, attached to *Limnacea acuminata* and was not in a state fit for close study and exact identification. The body, presenting a dark grey colour in spirit, is fusiform and of small size, being about 5 mm. in length. This leech may be referred to Blanchard's *Helobdella gracilis* from Java described by that author.

Sub-order ARHYNCHOBDELLAE.

Family HERPOBDELLIDAE.

Genus *Herpobdella*, de Blainville.14. *Herpobdella lineata* (O. F. Müller), 1774.

Hirudo lineata (O. F. Müller), 1774.

Nephelis quadristriata, Grube, 1850.

Nephelis lineata, Budde Lund, 1873.

Dina blasei, R. Blanchard, 1892, 1893, 1894.

Dina lineata, *ibid.*, 1892.

Nephelis gallica, *ibid.*, 1893.

Dina quadristriata, *ibid.*, 1894.

Nephelis bistriata, Brandes, 1900.

Herpobdella bistriata, Johansson, 1909.

Several specimens of *Herpobdella lineata* were collected by Col. H. T. Pease at Lahore. This species is of wide distribution, having been known to occur in Europe, Palestine, Siberia, Mongolia, North and Central America, Madeira and the Azores.

The body in the preserved condition is elongate, flattened, and of a uniform width for the greater part of its length, though it is attenuated anteriorly. Large specimens are about 25 mm. in length by 3 mm. across at the middle of the body.

The colour in spirit is brownish-yellow without any trace of the longitudinal stripes which are usually a conspicuous feature of the colouration of the typical form.

Somites i, ii and xxvii are uniannulate; iii, iv and xxvi biannulate; v and xxv triannulate: the nineteen somites vi-xxiv are complete with five rings, of which the last ring, although often difficult to detect, is usually enlarged and divided transversely by a superficial furrow. Occasionally the same subdivision is true of the ring forming somite ii.

There are in all four pairs of eyes of which the first and second pairs lie in a transverse curved line in somite ii and the third and fourth are placed in the first ring of somite iv.

The male genital orifice lies on the second ring of somite xi, the female orifice is two rings behind the male, that is between the fourth and the last ring of the same somite.

The anus lies on the dorsal surface between somites xxv and xxvi.

15. *Herpodbella hexoculata*, sp. nov.

(Text-fig. 3.)

Numerous examples of this species, which appears to be new to science, were collected by Dr. F. H. Gravely at Burhampur and Hoshangabad, as well as by Dr. N. Annandale from the Baitul-gharib stream about eight miles from Nowshera in the Peshawar District.

The body in the preserved state is elongate, flattened, attenuated anteriorly, bluntly rounded posteriorly, and of nearly similar breadth posterior to the genital region. The posterior sucker is

small and circular in outline, its diameter being about 1 mm. The large examples measured about 25 mm. in length and 2 mm. in breadth at the middle of the body.

The colour in spirit is light brownish yellow, marked with irregular pigment present all over in reticular distribution.

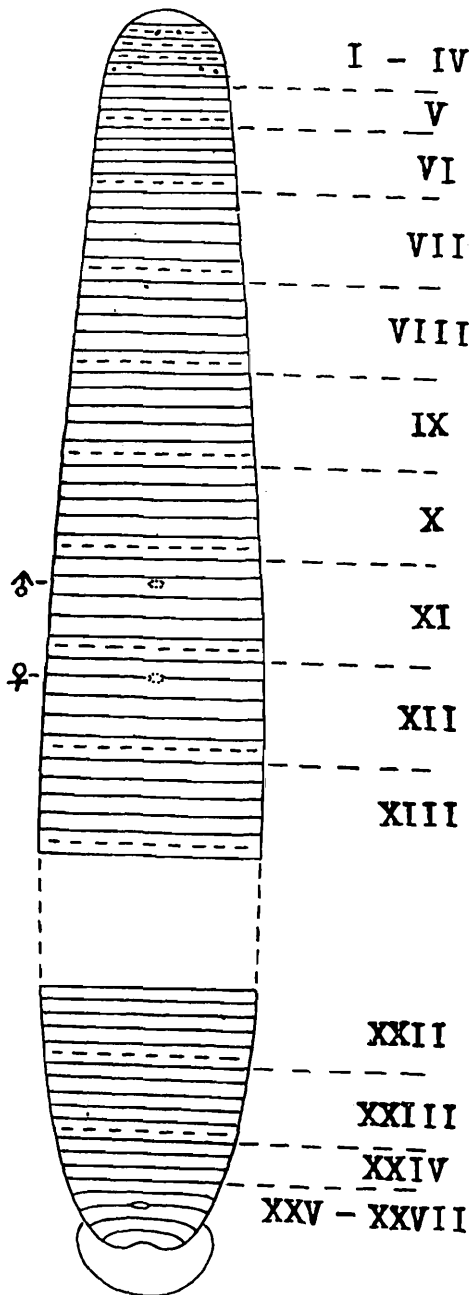
The rings forming the body number in all 107, which appear to resolve themselves as follows: somites i, ii and xxvii are uniannulate, iii, iv, xxv and xxvi biannulate; v and xxiv triannulate; eighteen somites vi-xxiii are complete with five rings, of which the last ring in each somite is broader than the others, being transversely subdivided into two primitive rings. The same is true of rings 2, 3, 4, 9, etc.

There are three pairs of eyes, the first pair lying in somite ii and the second and third pairs being situated in the first ring of somite iv, as is the case with *Herpobdella weberi* (R. Blanchard).

The male genital orifice exists on the second ring of somite xi; the female orifice lies five rings behind that of the male, that is between the first and second rings of somite xii.

The anus is situated on the dorsal surface between somites xxv and xxvi.

The present species is nearly allied to *Herpobdella weberi* which is known to occur in Java, Sumatra and Celebes, but may be distinguished from it chiefly by the absence of the two supplementary genital orifices on the ventral surface.



TEXT-FIG. 3.—*Herpobdella hexoculata*, sp. nov.

Diagram of the anterior and posterior extremities, as seen from the dorsal side.

Genus *Herpobdelloidea*, nov.16. *Herpobdelloidea lateroculata*, sp. nov.

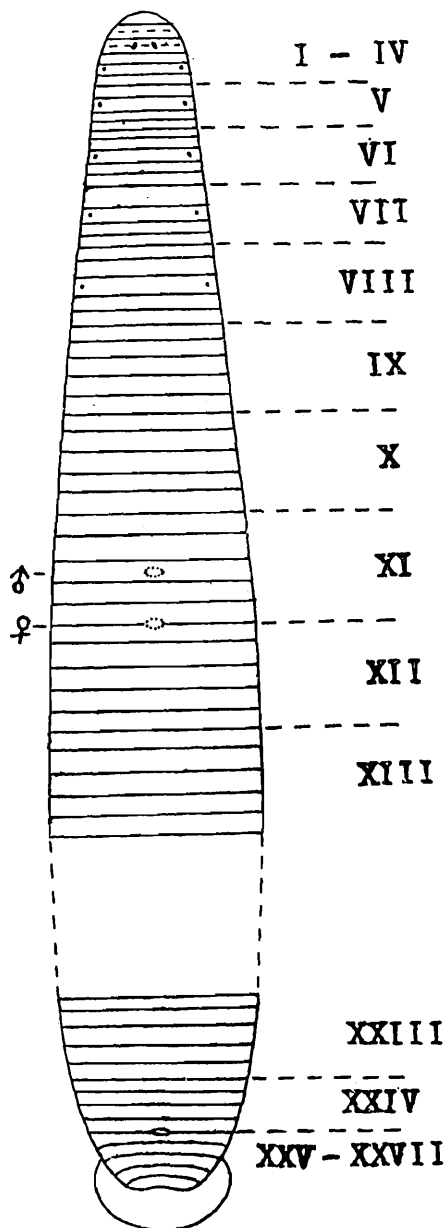
(Text-fig. 4.)

Some examples of this interesting species, which seems to be new to science, were collected by Dr. F. H. Gravely at Burhampur and also at Saugor in the Central Provinces.

This leech presents a great resemblance in its form and size to the preceding two species. The body is of nearly similar breadth posterior to the genital region, from which it tapers gradually towards the anterior end. The dorsal surface is more or less rough all over, owing to the presence of minute papillae which present no regularity in arrangement. Most of the specimens are of similar dimensions, measuring about 14 mm. long by 3 mm. broad at the middle of the body.

The colour is faded in spirit to a pale yellow, on some occasions revealing the male genital elements as an irregular dark longitudinal stripe on each side of the body, extending from behind the female orifice to the anal region.

Counting the first ocu-
liferous ring as the first ring there are in all 109 rings, which appear to be grouped somewhat as follows,—
somites i, ii, iii and xxvii are uniannulate; xxv and xxvi biannulate; iv triannulate; v and xxiv quadriannulate, of which the latter occasionally bears five rings owing to the subdivision of the last ring. The eighteen somites vi–xxiii are complete, each being formed of five rings of nearly similar width. On some occasions



TEXT-FIG. 4.—*Herpobdelloidea lateroculata*, gen. et sp. nov.

Diagram of the anterior and posterior extremities: dorsal view.

rings 2 and 3 are transversely subdivided into two primitive rings.

As is seen from text-fig. 4, there are six pairs of eyes, of which the first and largest pair occur dorsally on either side of the median line in somite iii, while the other pairs are arranged submarginally on the ventral side. The second pair lie in the second ring of somite iv; the third in the second rings of somite v, the remaining three pairs respectively in the middle ring of each of somites vi-viii. The last pair represents the smallest spots. Occasionally just in front of the first pair occur a small pair of provisional eye-spots.

The male genital orifice is placed on the middle ring of somite xi; the female orifice lies two rings behind the male, that is between somites xi and xii.

The anus is situated dorsally between somites xxiv and xxv.

As is apparent from the above, the present species seems to be closely related to the genus *Herpobdella*, but stands distinctly at variance from it in the six pairs of eyes, of which the first pair occur dorsally in somite ii, the other five pairs laterally in each of somites iv-viii respectively. It appears to me that the difference is of sufficient value to separate the two forms generically.

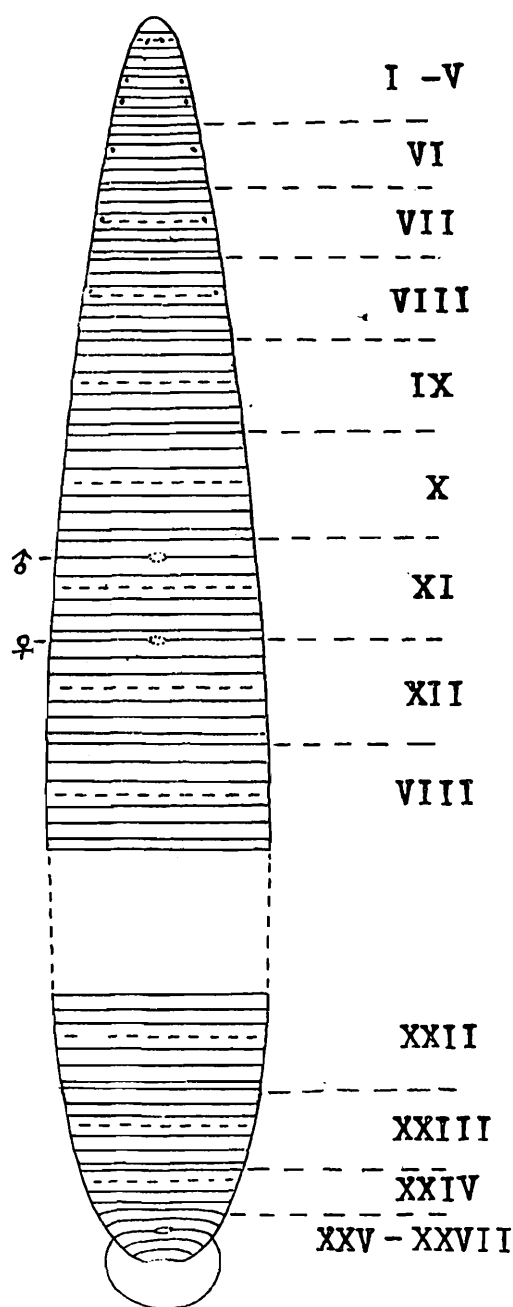
Genus **Nematobdella**, nov.

17. *Nematobdella indica*, sp. nov.

(Text-fig. 5.)

Some representatives of this interesting leech were found at the base of the Simla Hills near Dhurampur Kooa, Patiala State.

The body is elongate, slender, and of a nearly uniform breadth for its greater length, though it



TEXT-FIG. 5.—*Nematobdella indica*, gen.
et sp. nov.

Diagram showing the anterior and posterior extremities, as seen from the dorsal side.

tapers towards the anterior more than the posterior end, which is bluntly rounded. The papillae are very weakly developed on the dorsal surface and present no regularity in arrangement. The posterior sucker is a small circular disc with a diameter about half as wide as the greatest breadth of the body. The large specimens are 45 mm. in length by 4 mm. across at the middle of the body.

The colour is faded in spirit, being a translucent olive-brown without any trace of pattern.

The external rings, numbering about 126, are grouped somewhat as follows,—somites i, ii and xxvii are uniannulate; iii, xxv and xxvi biannulate; iv, v and xxiv triannulate; the eighteen somites vi–xxiii are complete with six rings, which are not of similar width, the third ring being enlarged and the last the narrowest of all. The enlarged ring in each typical somite is divided transversely by a superficial furrow. The same is true of the ring corresponding to somite ii.

The six pairs of eyes are arranged in similar manner to those found in the preceding species. The first pair are placed dorsally in ring 2, while the other pairs occur on the ventro-lateral side of the body. The second pair lie in the second ring of somite iv; the third in the first ring of somite v; the other three pairs respectively in the third ring of each of somites vi–viii.

The male genital orifice is situated between the first and second rings of somite xi; the female orifice is five rings behind the male, between somites xi and xii.

The nephridial pores, although difficult to detect, are situated in the furrow separating the second and third rings of the complete somite.

The anus opens dorsally between somites xxv and xxvi.

The clitellum embraces about four somites, ix–xii.

This interesting leech agrees in its arrangement of eyes with the preceding species, but it is separable from it chiefly in having the complete somite with six rings, which, as mentioned above, are not of similar breadth.

Genus *Foraminobdella*, nov.

18. *Foraminobdella heptamerata*, sp. nov.

(Text-fig. 6.)

A single representative of this interesting species was found by Capt. R. B. Seymour Sewell, I.M.S. in a stream at Neduattan, at an altitude of 6200 ft., in the Nilgiri District, Madras. The specimen had not been preserved in a state satisfactory for close examination.

The body, which is oval or circular in cross section, is smooth on the surface and of nearly similar breadth for the greater part of its length. The posterior sucker is small and circular in outline, its diameter being about half as wide as the greatest width

of the body. The length of the body is 40 mm. and the breadth about 5 mm. at the middle.

The dorsal surface is of a black colour, while the ventral surface is much lighter than the dorsal, and of an olivaceous colour.

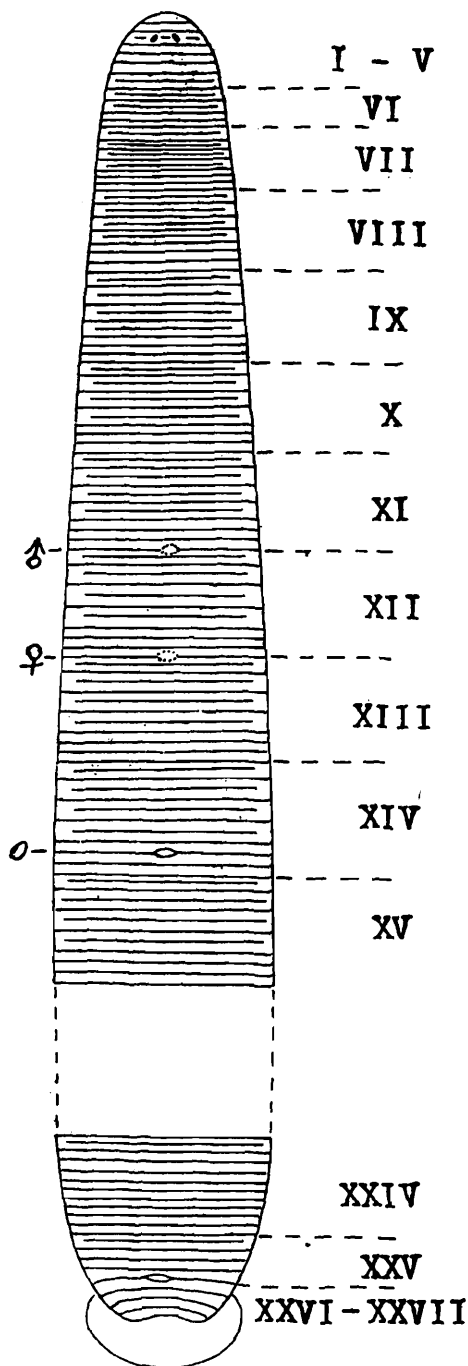
The somites, although not traced out definitely may be regarded as being grouped somewhat as follows,—somites i, ii and iii are uniannulate; iv, xxvi and xxvii biannulate; v triannulate; vi and xxv quadriannulate, the eighteen somites vii–xxiv are complete with seven rings. In each typical somite the first four rings are enlarged and usually divided transversely either superficially or completely, but the remaining three are narrow. In somite v the last two rings are fused on the ventral surface to form the posterior margin of the anterior sucker. The superficial division is to be seen in the ring corresponding to somite iii, in the first and second rings of somite vi as well as in the first ring of somite xxv.

There are a pair of eyes which are placed in ring 3.

The male and female genital orifices are separated by seven rings, being situated respectively just behind the last ring of somites xi and xii.

Great interest is attached to an external opening

of the digestive tract, which occupies a position on the mid-dorsal surface, as is the case with *Trematobdella perspicax* (R. Blanchard). So far as my observation goes, it seems to lie between the fifth and sixth rings of somite xiv. Such a peculiar opening of the digestive tract is also known to occur in Horst's *Nepheleis dubia* from Sumatra, described by that author, in which the tract opens to the exterior on the ventral surface by a pair of slender



TEXT-FIG. 6.—*Foraminobdella heptamerata*, gen. et sp. nov.

Diagrammatic representation of the anterior and posterior extremities; dorsal aspect. o., dorsal opening of digestive tract.

passages. The openings lie twenty rings behind the male genital orifice.

The anus lies on the dorsal surface between somites xxv and xxvi.

The clitellum embraces four somites, x-xiii.

In spite of the existence of a dorsally situated opening of the digestive tract, this leech may be distinguished from *Trematobdella* by the difference in the number and arrangement of rings composing the typical somite, in this respect it seems to be somewhat related to *Mimobdella*. To me it appears to represent a new genus of the Herpobdellidae.

Genus *Scaptobdella*, R. Blanchard.

19. *Scaptobdella horsti*, R. Blanchard, 1897.

I refer five specimens from Java to Blanchard's *Scaptobdella horsti* which is known to occur also in Sumatra and Borneo. The present material was found at an elevation as high as about 4700-6500 ft. in Tjibodas.

The body, presenting some resemblance in its external feature to the earth-worm, is soft, smooth on the whole and oval or circular in cross section, its anterior end being narrower than the rounded posterior end. The lateral sides of the body are nearly parallel for the greater part of its length. The posterior sucker is in the form of a shallow circular disc with a diameter rather less than the breadth of the body. All the specimens are of nearly similar size, about 175 mm. long, exclusive of the posterior sucker, by 12 mm. across.

The ground colour, though faded in spirit for the most part, is dark olive without any trace of markings.

The complete somite is formed of six rings, of which the first two rings are broadest, in most instances being divided transversely by a superficial furrow into primitive rings. On some occasions, especially in the hind region of the body, the same subdivision is to be found on the other narrower rings of each typical somite, excepting the fifth ring.

No trace of visual organs has been detected in the present species.

The male genital orifice lies between the third and fourth rings of somite xi, and the female orifice is six rings behind the male, that is on the third ring of somite xii. In one case there is found a minute aperture at the dorso-lateral edge of the ring just behind that bearing the female orifice.

The anus is placed on the dorsal surface just in front of the last three rings of the body.

The clitellum embraces twenty-one rings, as described by R. Blanchard, extending from the second ring of somite x to the first ring of somite xiii.

Family GNATHOBDELLIDAE.

Genus *Whitmania*, R. Blanchard.20. *Whitmania laevis* (Baird), 1869.

Hirudo laevis, Baird, 1869.

Leptostoma pigrum, Whitman, 1886.

Whitmania pigra, R. Blanchard, 1887.

The two examples which I have identified with *Whitmania laevis* were collected by the Manipur Survey party at Pagla Nadi and from Thanga Island. This species is very wide in its distribution, being well known to occur in Japan, the Amur region, China, the Philippines, Malacca, India, Celebes, Sumatra and elsewhere.

The body is large and tapers considerably towards the anterior end. A short distance behind the anterior tip is a slight constriction in the specimen from Thanga Island. The specimen from the latter locality is of larger size than that from Pagla Nadi, and is about 140 mm. in length and 18 mm. in breadth at the middle of the body.

The anterior sucker is very small, lying ventrally within the limits of rings 1-6. The jaws, presenting three small alternate folds, are devoid of proper denticles, but are beset with two series of irregular, thin denticular plates, which are more or less united, especially at the outer and inner angles, where the two series bend, as mentioned by Whitman, into each other.

The posterior sucker is somewhat ventrally attached and circular in outline, about 8 mm. in diameter.

The body is formed of 107 rings, of which rings 6 and 7 are fused ventrally to form the posterior boundary of the anterior sucker, and rings 8 and 9 are also united on the ventral side. On the dorsal side coalescence is found between the two rings of somite xxvi. The same is true of the last two rings. All the rings are grouped, as usual, into twenty-seven somites as follows: somites i, ii and iii are uniannulate, iv, v, xxvi and xxvii biannulate; vi triannulate; vii and xxv quadriannulate; the seventeen somites viii-xxiv are complete with five rings.

The five pairs of eyes are arranged as in *Hirudo*, that is in rings 2, 3, 4, 6 and 9 respectively.

The segmental papillae are so regularly arranged as to exhibit six longitudinal rows on both sides, dorsal and ventral. In the complete somites they occur on the middle ring.

The male genital orifice in the two examples from Manipur occurs in the middle of ring 34, that is on the last ring of somite xi, and the female orifice is five rings behind the male, that is slightly anterior to the centre of the last ring of somite xii. Occasionally both the orifices are displaced near the anterior edge of the corresponding rings, appearing, in preserved specimens, to lie between the rings. In an example from Japan included in the collection the male and female openings appeared to be respectively between the last two rings of somites xi and xii.

The nephridial pores comprise in all seventeen pairs, lying in the furrow separating the second and third rings of the middle seventeen somites.

The anus opens on the dorsal surface just behind the last ring.

The body, though showing some individual variations in colour and markings, is usually brownish olive or olive-yellow, with five black stripes, one median and two lateral, along each of which are found, at regular intervals, oval or quadrangular spots which are free from pigment. In the second and third rings of each somite the spots are divided into two by a transverse line. On each side of the median stripe is seen a shadowy stripe, which, in some instances, may be marked by clear spots. The margins of the body are generally of a lighter colour, bordered on the inner side with a narrow stripe of black, or with flecks of the same colour. A specimen from Japan is of a greyish-olive colour with dark brown stripes, along which the spots are much reduced in size or sometimes wanting.

The ventral surface is generally dotted with black flecks, which alongside the lateral margin are so numerous that they form broad black borders.

Genus *Limnatis*, Moquin-Tandon.

21. *Limnatis nilotica* (Savigny), 1822.

I have examined a single example¹ identical with *Limnatis nilotica*, which occasionally attaches itself to the mouth, throat, and nasal cavity of human beings and cattle, generally causing haemorrhage. It represents one of six specimens obtained at Quetta, Baluchistan, from the throat of an Austrian soldier.

This leech has a wide distribution, extending from the Azores, through part of Western Europe as well as Northern Africa, to part of Western Asia, and even into the boundaries of the Indian Empire. It can be easily distinguished from the following, *L. granulosa*, by the difference in colour markings.

22. *Limnatis granulosa* (Savigny), 1820.

This species represents one of the commonest Indian leeches, numerous examples having been collected at several localities: Panjab, Bombay, Mysore, Madras, Orissa, Bihar, Assam, Burma, Ceylon and elsewhere. As has been mentioned in a recent account (*loc. cit.*), this leech exhibits great variability in colour and markings.

L. javanica (Wahlberg), which is known to occur in Java, Borneo, Sumatra, Burma, Bengal, etc., is nearly allied to the present species, but can be easily distinguished from it by the separation of the genital orifices by seven instead of five rings as well as by the enormous size of its posterior sucker.

¹ See Kaburaki, *Rec. Ind. Mus.* XVIII, p. 213 (1921).

Genus *Haemopsis*, Savigny.23. *Haemopsis sanguisuga* (Linnaeus), 1758.

The three specimens of this well-known leech, which occurs throughout the greater part of Europe, were obtained by Capt. R. B. Seymour Sewell from the Waddi Gwyzie (Gaza) in Palestine. It is of particular interest that its range extends into Transcaucasia, Syria and Palestine. As is well known the term "horse-leech" or "cattle-leech" is applied to this species more than *Limnatis nilotica*; it frequently occurs in springs, and thereby causes great discomfort and even danger. This species has, especially in the last few years, been subjected to many changes of name (see Harding, 1910).

The body is smooth on the surface, attenuated anteriorly and bluntly rounded posteriorly, its lateral sides being more or less parallel for the greater part of its length. The posterior sucker represents a large circular disc and is almost centrally attached. The largest specimen was 30 mm. long, in front of the posterior sucker, by 11 mm. across at the middle of the body.

The colour in spirit is dark brownish, appearing to show some traces of geometrical patterns on the dorsal surface.

There are 103 rings, of which rings 6 and 7 are fused ventrally to form the posterior boundary of the anterior sucker. The same is true of rings 8 and 9 on the ventral side. Somites i, ii, iii and xxvii are uniannulate; iv, v and xxvi biannulate; vi, vii and xxv triannulate, viii quadriannulate; the sixteen somites ix-xxiv are complete with five rings.

The five pairs of eyes lie respectively in rings 2, 3, 4, 6 and 9.

The male genital orifice is situated between rings 31 and 32, that is between the fourth and fifth rings of somite xi, the female orifice lies five rings behind the male, that is between the last two rings of somite xii.

The nephridial pores, numbering in all seventeen pairs, are placed in the furrow between the second and third rings of the middle seventeen somites.

The anus opens dorsally just behind the last ring of the body.

24. *Haemopsis birmanica*, R. Blanchard, 1894.

Haemopsis weberi, R. Blanchard, 1897.

The collection contains some examples of a species which agrees precisely with Blanchard's *Haemopsis weberi* from Sumatra. The latter may be regarded as synonymous with *H. birmanica* from Burma described by the same author, and here I have so treated it. This leech is closely allied to *Haemopsis sanguisuga*, so that I was for some time inclined to regard it as a variety of that species. The specimens examined were obtained from various parts of the Darjiling District, the East Himalayas, at Lahore and also at Khunlan in Siam. It is of some interest that an example from Lahore was found in the nasal cavity of a horse.

The body is very closely similar in its external features to *Haemopsis sanguisuga*, being entirely devoid of segmental papillae and possessing a large posterior sucker. The largest specimen is 145 mm. in length, exclusive of the posterior sucker, and 18 mm. in width at the posterior region of the body.

The colour in spirit is dark grey on the dorsal and lighter on the ventral surface, without being marked with any trace of pattern.

Counted on the dorsal surface are 104 rings, of which rings 6 and 7 are fused on the ventral surface to form the posterior margin of the anterior sucker. The same is true of rings 8 and 9 on the ventral surface. On some occasions ring 14 is subdivided transversely into two on the ventral surface, and rings 96 and 97 present a tendency to fuse on the dorsal surface. Somites i, ii and iii are uniannulate; iv, v, xxvi and xxvii biannulate; vi, vii and xxv triannulate; viii quadriannulate dorsally, but occasionally with five rings ventrally owing to the subdivision of the first ring (14). The sixteen somites ix-xxiv are complete with five rings.

The eye-spots are very small and are not discernible easily from the exterior, their arrangement quite agreeing with that found in *Haemopsis sanguisuga*.

The male genital orifice is situated near the anterior edge of the last ring of somite xi, and the female orifice lies five rings behind the male, between the fourth and fifth rings of somite xii.

The anus is situated on the dorsal surface just behind the last ring of the body.

The clitellum extends over four somites, x-xiii.

25. *Haemopsis concolor*, sp. nov.

(Text-fig. 7.)

The three individuals, which seem to represent a new species, were collected by Dr. B. Prashad from a spring at Kasauli in the Western Himalayas.

In shape the body is much like the preceding two species and is smooth on the whole, there being neither papillae nor tubercles to roughen the surface. The larger specimen is 40 mm. long by 6 mm. broad, while the smaller is 5 mm. long by about 1.5 mm. across.

The body is of a dark olive colour, without any trace of markings.

In front of the posterior sucker there are 103 rings, of which rings 8 and 9 are fused on the ventral side. Somites i, ii, iii and xxvii are uniannulate; iv, v and xxvi biannulate; vi, vii and xxv triannulate; viii quadriannulate; the sixteen somites ix-xxiv are complete with five rings. In the small examples the furrows marking the boundaries of the somites appeared somewhat conspicuous in consequence of the curvature which the body had assumed in preservation. It is of some interest that the furrows separating the rings in some somites are not of similar depth, differing from

the other species of *Haemopsis*. The shallower furrow is the one separating some rings of somites vii-xi and xxvi, as is shown in text-fig. 7 by the broken line.

The arrangement of eyes is in agreement with that of *Haemopsis sanguisuga*.

The male and female genital orifices occupy a position respectively between the last two rings of somites xi and xii.

The nephridial pores are situated in the furrow between the second and third rings of the middle seventeen somites

The anus is located on the dorsal surface just behind the last ring of the trunk.

This leech appears to be nearly allied to *Haemopsis sanguisuga*, but may be distinguished from it by the different annulation of the body.

Genus *Myxobdella*, Oka.

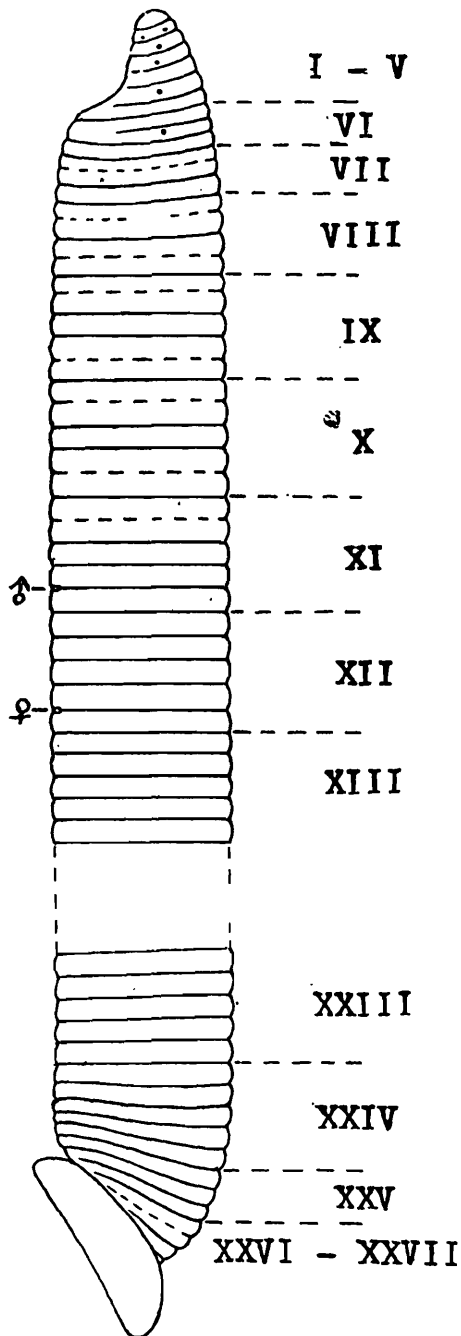
26. *Myxobdella annandalei*, Oka, 1917.

There was in the collection a single example which may be identical with Oka's *Myxobdella annandalei* from Hong Kong described by that author. The specimen was found in a hill stream at Yercaud, Madras.

The body is smooth on the whole, entirely devoid of papillae and almost uniformly broad for the most

part, though it tapers off considerably in front. The dorsal surface is convex throughout while the ventral is nearly flat. The posterior sucker is circular in outline and in the preserved state is entirely hidden when viewed from above. The specimen measured 17 mm. in length and about 4 mm. in breadth at the middle of the body.

As has been described by Oka in detail, the most conspicuous of the external features is that the body is divided by deep furrows



TEXT-FIG. 7.—*Haemopsis concolor*, sp. nov.

Diagram of the anterior and posterior extremities, as seen from the lateral side.

into well-bounded somites. So far as my observation goes, somites i, ii, iii and xxvii are uniannulate; iv, v and xxvi biannulate; vi, vii, xxiv and xxv triannulate; viii and ix quadriannulate; the fourteen somites x-xxiii are complete with five rings. In each typical somite the furrows separating the rings are not of equal depth, the deepest ones being always found between the second and third as well as the third and fourth rings. The furrow between the first and second rings is, in most instances, the shallowest of all.

The five pairs of eyes are arranged in the same manner as those observed in *Hirudo* or *Haemopis*.

The male and female genital orifices are placed between the fourth and fifth rings of somites xi and xii respectively.

The anus opens on the dorsal surface just behind the last ring of the body.

Genus *Haemadipsa*, Tennent.

27. *Haemadipsa zeylanica* (Moquin-Tandon), 1826.

Hirudo zeylanica, Moquin-Tandon, 1826.

Hirudo flava, Schmarda, 1861.

Hirudo (*Chthonobdella*) *sumatrana*, Horst, 1883.

Haemodipsa sylvestris, R. Blanchard, 1894.

In his paper R. Blanchard puts on record a form closely resembling the present leech as a distinct species, *Haemadipsa sylvestris*, chiefly on account of the presence of a narrow interpolated ring between the two oculiferous rings 4 and 5, which, according to a careful examination of a large series of examples, appears not to be of a constant occurrence. I am, therefore, of the opinion that this difference may be regarded as being of insufficient value to separate the two forms specifically.

As is well-known, the species is of wide distribution in the Oriental region, it having hitherto been recorded from Ceylon, the Himalayas, Burma, Cochin China, Tonkin and also from various localities in the Indo-Malayan Archipelago, such as Sumatra, Borneo, Celebes, Java, etc. The collection which I have examined contained a great number of this species obtained from several localities in India and its vicinity: at elevations of 1300-6500 ft. in the Darjiling District, the East Himalayas, Assam, Central Provinces, Madras, Lower Burma and elsewhere.

The body is nearly cylindrical, tapering gradually towards the head end. Centrally attached is a circular posterior sucker which is rather less than the greatest width of the body. The large specimens are about 40 mm. long, excluding the posterior sucker, by 7 mm. across at the posterior region of the body.

The body consists generally of 98 rings, of which rings 5 and 6 coalesce ventrally to form the posterior margin of the anterior sucker. Among the examples with the same colour markings from Kovalai, at elevations of 1300-3000 ft., in Cochin State, there was one individual only in which rings 7 and 8 are also fused on the ventral side. On some occasions a narrow ring occurs interpolated between the oculiferous rings 4 and 5, but this, so far as my observa-

tion goes, is not constant in occurrence, as mentioned above. Somites i, ii, iii, iv, xxvi and xxvii are, it seems to me, uniannulate; v and xxv biannulate; vii and xxiv triannulate; viii quadriannulate; the fifteen somites ix-xxiii are complete with five rings. Occasionally somite iv is composed of two rings owing to the presence of a narrow interpolated ring.

There are five pairs of eyes, of which the first four pairs are usually arranged in a semicircle in rings 2, 3, 4 and 5, and the fifth pair lie two rings behind the fourth, that is in ring 8.

On both sides, dorsal and ventral, are found six segmented papillae which generally fall on the middle ring of each typical somite.

The male and female genital orifices are separated by five rings, lying between the last two rings of somites xi and xii respectively.

The nephridial pores, numbering in all seventeen pairs, open laterally in the furrow separating the second and third rings of the middle seventeen somites.

The anus opens dorsally just behind the last ring of the body.

The clitellum extends over four somites, x-xiii.

This species is generally of a yellowish colour variegated with brown, but exhibits great variability in markings. So far as my observations are concerned, there are distinguishable four varieties, which occur associated together, but with some intergrading forms.

(i) In a few specimens from the East Himalayas and Bengal the dorsal surface is divided into three longitudinal areas, a median and two lateral. The median area is lighter in colour, and slightly narrower than the lateral areas which present a dark brown colour, getting lighter towards the lateral margins of the body. The median area is traversed longitudinally by a thick dark brown median stripe, which extends with the lateral bands throughout the whole length of the body, but in some cases it vanishes, or nearly so, on the dark head end.

(ii) Some examples obtained from several localities of the Assam, Bengal and Bihar Districts, as well as of Lower Burma, are generally marked on the dorsal surface with three fine dark brown stripes, one median, and on each side one lateral, in position corresponding to the boundary line between the median and lateral areas mentioned above. On some occasions the median stripe is faint or sometimes obsolete.

(iii) In examples from several places in the East Himalayas and Cochin State the markings agree in their plan with the forms mentioned above, but may be distinguished from these by the different aspect of the lateral bands which are very faint or sometimes obsolete.

(iv) In some forms from the East Himalayas, North Kanara, Madras and Cochin State the body is marked on both sides, dorsal and ventral, with dark brown blotches, which occasionally join together in the positions corresponding to the dorsal and lateral areas.

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XXXI RECORDS OF SOME INDIAN CICINDELIDAE.

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Having recently had occasion to re-arrange the Cicindelidae in the collection of the Zoological Survey of India, we found that it contained many specimens from localities unrecorded by Canon Fowler in his volume on the Cicindelidae and Paussidae in the "Fauna of British India" series; and, as in most other groups of Indian insects, much remains to be known about their geographical distribution, we have drawn up the following note in the hope that it will be useful. We have endeavoured to incorporate the few records of Indian species that have been published since Fowler's volume appeared.

It may be mentioned that most of the specimens listed here have been collected by the officers of this department; especially by Dr. S. W. Kemp, in Assam and elsewhere, and Dr. F. H. Gravely in the Darjiling District. Dr. and Mrs. Kemp's collection from the Garo Hills, Assam, made in July and August, 1917 is perhaps the most interesting recent addition to the collection, as these hills were hitherto practically unexplored.

The identifications of all the more critical species mentioned in this paper have been verified by Dr. Walther Horn.

Collyris brevipennis, Horn. Talewadi near Castle Rock, N. Kanara Dist. (Kemp, 3-10.x.16) and Castle Rock (11-26.x.16). Dr. Kemp tells us that he took the Talewadi specimen on a small bush while it was boring with the posterior end of its body into one of the branches, presumably with a view to oviposition.

Neocollyris redtenbacheri, Horn. Tura, Garo Hills, Assam, 200-1500 ft. and above Tura, 3000 ft. This species is not rare in the Darjiling Dist., from 1500-5000 ft. It has also been taken in Kousanie, Kumaon, 6075 ft. (Tytler, 25.vii.14).

Neocollyris attenuata, Redt. Darjiling Dist., from 1500-5000 ft.

Neocollyris variitarsis, Chaud. Tura, 1200-1500 ft., and Singla, Darjiling Dist., 1500 ft.

Neocollyris variicornis, Chaud. Tura, 1200-1500 ft., Sitong near Mungphu, 3800-4000 ft., Darjiling Dist. (Kemp, 2-5.vii.18) and Singla, 1500 ft. The species has also been taken in Tonkin.

Neocollyris bonelli, Guer. Rangamati, Chittagong Hill Tracts, (Hodgart, 11-16.vii.15), Siripur, and Khargpur, Bengal. Sib-sagar, Khasi Hills, and above Tura, Assam, Hills near Taiping, Perak (Annandale, 26-30.xii.15). This species is widely distri-

buted in Bengal and Fowler's doubt of the Calcutta locality seems, therefore, uncalled for. The variety *ortygia* Buq., has been taken in Siripur (26-27.ix.10), Singla, 1500 ft. and Tura. We have specimens from Pashok, 3500 ft., Darjiling dist. and Tura under the name "var. *diversipes*, Fowl!", but Dr. Horn who examined one of these says that they are really intermediate forms between *N bonelli* and *distincta*. In the "Fauna" volume *distincta* is given specific rank, but it is best considered as a subspecies of *bonelli*. We have examples of *distincta* from Balighai near Puri, Orissa (*Annandale* and *Gravelly*, 16-20.viii.11).

Neocollyris fuscitarsis, Schm.-Goeb. Singla, Darjiling Dist., 1500 ft.

Neocollyris saphyrina, Chaud. Pashok, 2500 ft., Darjiling Dist.

Neocollyris insignis, Chaud. Above Tura, Garo Hills, Assam, 3900 ft. In India the species appears to be entirely confined to the hills, and is rather common in the Darjiling Dist.

Neocollyris smaragdina, Horn. Soom, Darjiling Dist., 4000-5000 ft (7.vii.14).

Neocollyris feae, Horn. Rangamati, Chittagong Hill Tracts, (*Hodgart* 11-16.vii.15).

Tricondyla gounelli, Horn. Trivandrum, Travancore.

Tricondyla macrodera, Chaud. A common species in the Darjiling Dist. and in Assam. Dr Kemp took fifteen examples at Tura, and above Tura, on the doorstep of his bungalow and on tree-trunks.

Tricondyla mellvi Chaud. Above Tura, 3500-3900 ft.

Derocrania longesulcata, Horn. Castle Rock, N. Kanara Dist. (*Kemp*, 11-26.x.16).

Therates hennigi, Horn. Above Tura, 3900 ft. Dr Kemp says that the species was rare in the Garo Hills where it occurred only in one place, about 100 ft. below the top of the ridge. The jungle on either side of the path in this locality consisted of very large trees with light undergrowth.

Therates dohertyi, Horn. Pashok, 5000 ft., Darjiling Dist. (*Hartless*).

Therates chenelli, Bates. N. Shan States, U. Burma (*Mackwood* 4.v.14).

Therates obliquus, Fleut. Pashok, 5000 ft. (*Hartless*).

Therates gestroi, Horn. A common species above Tura in the Garo Hills, 3500-3900 ft. The subspecies *annandalei* is common in damp shady places, among shrubs and herbage, almost throughout the Eastern Himalayas.

Prothyma proxima, Chaud. Balugaon, Puri Dist., Orissa (*Annandale*, 21-30.vii.13) and Coimbatore, S. India (*Fletcher*, 18.xi.13).

Prothyma reconciliatrix, Horn. Above Tura, 3500 ft.

Heptodonta nodicilis, Bates. A widely distributed species in the Darjiling Dist. and Assam. Fleutiaux records it from Tonkin.

Heptodonta kraatzi, Horn. A fairly common species above Tura, 3000–3500 ft. and in the Darjiling Dist. from 1500–5000 ft.

Heptodonta pulchella, Hope. Not an uncommon species at Tura, 1000–1200 ft. *H. ferrarii*, Gestro, is sunk as a synonym of this species by Fowler, but Fleutiaux in a recent paper (1917) seems to consider it distinct, and after carefully examining the specimen in the Indian Museum we cannot but agree with him. Our example is from the N. Shan States, Upper Burma (*Mackwood*, 4.v.14), and the species is also recorded from the Karen Hills in Burma and Laos.

Cicindela viridicincta, Horn. Mr. Fletcher has taken this species in Pollibetta, Coorg, S. India (15–25.v.14).

Cicindela tetrastacta, Wied. Annandale and Dover record this species from Barkuda I., and Gantasila on the Chilka Lake.

Cicindela dromicoides, Chaud. Not uncommon in the Darjiling Dist., and Kumaon. Dr. Gravely has taken a specimen in Ghumti, Darjiling Dist., 4000 ft., with the elytron of a common small Chrysomelid in its mandibles. The *Cicindela* probably feeds on the Chrysomelid.

Cicindela triguttata, Hbst. Rangamati, Chittagong Hill Tracts, (*Hodgart*, 11–16.vii.15), Siliguri, base of E. Himalayas (*Annandale* and *Kemp*, 3–4.vi.11), Darjiling Dist., 600–4500 ft., Tura, Garo Hills, and Tonkin.

Cicindela umbropolita, Horn. Mr. Fletcher has taken this species at Coorg, S. India, in May, 1914.

Cicindela foveolata, Schaum. Tura, 1200 ft., Nilgiri Hills, 3000 ft., and Tonkin.

Cicindela spinolae, Gestro. Rangamati and Tura, 1000–1500 ft. A jungle species fairly common in the Eastern Himalayas.

Cicindela bigemina, Klug. Siliguri (3–4.vii.11), and Chakradharpur, Chota Nagpur (*Gravely*, 1.x.11). The *habitat* of the variety *brevis*, Horn, is given by Fowler as “Indes Orientales.” We have specimens from the bank of the River Sohan in Rawalpindi, Punjab (*Hodgart*, vi–vii.17).

Cicindela viridilabris, Chaud. Fowler gives the *habitat* of this species as “East Indes,” but remarks that Dr. Horn thinks that they are probably from North India. Mr. Hodgart has taken it in Kalka at the base of the Simla Hills, 2400 ft., in July, 1917.

Cicindela seriepunctata, Horn. A widely distributed form in the Eastern Himalayas.

Cicindela fastidiosa, Dej. Annandale and Dover record this species from Barkuda I., Chilka Lake, where they took brownish, greenish and bluish specimens.

C. decempunctata var. *obscure-dilatata*, Horn. A species recently described by Horn (1914, p. 28) from Delhi. We have a single specimen from Lahore, Punjab (*B. Das*, 5.x.12, “river-side”).

Cicindela melancholica, Fabr. Kalka, base of Simla Hills, 2400 ft. (*Annandale*, 21.vii.11, “in railway carriage”), Ambala, Punjab (*Annandale*, 16.vii.11, “in railway carriage”), Kaladhungi, Naini Tal Dist. (*Hodgart*, 4–6.v.13), and Bushire, Persia.

Cicindela undulata, Dej. Annandale and Dover record this species from Barkuda I., and elsewhere. The variety *dubia*, Horn is recorded doubtfully in the "Fauna" from "India." We possess specimens from Singla, Darjiling Dist., 1500 ft., and Mandalay in Upper Burma (Molesworth, 1915, "at light").

Cicindela imperfecta, Chaud. Fowler records it from various localities, but adds a note to the effect that Dr. Horn says that some of these records may be erroneous, as this species is known only from Bengal. The Museum possesses two specimens: one from Surat in Bombay, and the other from Ranchi, which are certainly authentic.

Cicindela distinguenda, Dej. This species is recorded from Pondicherry and Ceylon, and Annandale and Dover record a single specimen from the shore of Barkuda I., Lake Chilka.

Cicindela discreta var. *reducta*, Horn. Tura, Garo Hills, 1000-1500 ft.

Cicindela grammophora, Chaud. Widely distributed in Bengal. We have specimens from Kaladhungi, Naini Tal Dist. (Hodgart, 4-6.v.13).

Cicindela cognata, Wied. Dr. Gravely has taken this species on the banks of the River Mahanadi in Cuttack, Orissa (21-22.viii.11) and Mr. Hodgart in Goalbathan, E. Bengal (9.vii.09).

Cicindela minuta, Oliv. Tura, 1000 ft., and Garobadha (Kemp, 1.ix.17), Garo Hills, Assam; Orissa, Delhi, and Satara Dist., Bombay Presidency. Apparently widely distributed in India and Burma.

Cicindela nitida, Wied. Naini Tal Dist. and Orissa. The species though widely distributed is, like *C. biramosa*, which lives only on the seashore, curiously particular in its choice of *habitat*. It inhabits river-banks composed of dry mud with a good amount of sand. We have seen it in very large numbers on the bank of the River Bhagarati at Berhampur, Murshidabad District, in the beginning of July, 1921, where it lives in company with a Muscid fly to which it bears a remarkable resemblance on sunny days. Both the beetle and the fly are extremely difficult to catch as they seem to move by a series of unaccountably swift leaps, and with the sun shining on them it is impossible to tell the beetle from the fly. In the cabinet they bear no resemblance whatever to each other.

Cicindela angulata, Fabr. Tura, Garo Hills, Assam, 1000 ft., Sitong, Darjiling Dist., and Cuttack, Orissa (Gravely, 21-22.viii.11, "on bank of R. Mahanadi").

Cicindela sumatrensis, Hbst. A widely distributed species usually abundant where it occurs (*cf.* Annandale and Dover, 1921). The variety *imperfecta* Horn is found throughout the Bombay Presidency, and Dr. Gravely has also taken it in the Cochin State. We are of opinion that *C. despectata* Horn (1892, p. 86) from Perak in the Malay Peninsula and the Phillipines will probably prove to be only a form of *C. sumatrensis*.

Cicindela cardoni, Fleut. Satara Dist., Bombay Presidency,

2000 ft. In the Manbhum District of Chota Nagpur the species is not uncommon on sand by the river-bank.

Cicindela chloris, Hope. A common Western Himalayan species, taken also in the Darrang Dist., Assam-Bhutan Frontier (Kemp, 26·xii·10).

Cicindela funerea, McLeay. This form occurs in the Darjiling Dist., from 500–5000 ft., and almost throughout Assam. In the Garo Hills it is not uncommon at Tura, 1000 ft. Dr. Annandale has also taken it on the shore of Lake Talé Sap in Patalung, Siam.

Cicindela intermedia, Chaud.¹ Taken in Kumaon from 1200–6075 ft.

Cicindela octonotata, Wied. Sukna, 500 ft., E. Himalayas. (Annandale, 1·viii·08), Darjiling, Garobadha (Kemp, 1·x·17) and Tura, Garo Hills, Assam, 1200 ft.

Cicindela duponti, Dej. Tura, 1000–1400 ft. and Tonkin. The variety *barmanica*, Gestro, has been taken by Mr. Hannington at Coorg, 2000 ft., S. India, and by Mr. Mackwood in N. Shan States, U. Burma. The Museum possesses an example of *C. chinensis*, De Geer, from Simla, but Fowler thinks it probable that this locality is incorrect.

Cicindela aurulenta, Fabr. Hills near Taiping, Perak (Annandale, 26–30·xii·15), N. Shan States, U. Burma; Tamansari, Idjen Massip, 1600 ft., E. Java (Kloss, 1·20). The variety *virgula*, Fleut., is widely distributed in the Eastern Himalayas and in Assam. Dr. Kemp found it not uncommon at Tura, 1000–1400 ft. He has collected specimens of the variety *batesi* Fleut. (cf. Fleutiauxe 1893, p. 491) which is not recorded in the "Fauna", in the Doiphang Valley, Darrang Dist., Assam-Bhutan Frontier (21·x·12).

Cicindela hamiltoniana, Thoms. Mr. Fletcher has taken this form in Pollibetta, Coorg, and we have an example from Nadgani, Malabar.

Cicindela assamensis, Parry. Tura, Garo Hills, Assam, 1000–1500 ft., above Tura, 3000 ft., Pashok, 2000 ft., Darjiling Dist., and Rungbong Valley in Darjiling. In the Garo Hills the species is found in the same situation as *Therates hennigi*, but at lower altitudes.

Cicindela mouhoti var. *cariana*, Gestro. N. Shan States, U. Burma

Cicindela vigintiguttata, Hbst. Barkul, Puri Dist., Orissa (Gravely, 9–13·xi·12).

Cicindela striolata, Ill. Dr. Gravely in June, 1914 found this species not rare in long grass above jungle in the Darjiling Dist.,

¹. It might be of interest to mention here that a common African Cicindelid has long been known under the name *C. intermedia* Klug (1853), but as Chaudoir described the Indian species of this name a year earlier, Dr. Horn proposes to call the African form *C. intermediola*. I am indebted to Mr. C. N. Barker of the Durban Museum for this information. [C.D.]

3000–3500 ft. It has also been taken at Coorg and Rangamati. The variety *lineifrons* Chaud. is represented in our collection from above Tura, 2500 ft. (Kemp, 15.vii.17, "jungle path").

Cicindela albina, Wied. On banks of River Sohan at Rawalpindi, Punjab, and Lohardaga, Ranchi Dist., Chota Nagpur. At Balighai near Puri on the Orissa Coast Dr. Annandale found that it occurred only on sand dunes, not on the seashore.

Cicindela copulata, Schm.-Goeb. Fowler gives the distribution as Calcutta and Karachi, but remarks that the former is rather doubtful. Schmidt-Goebel described it from "Cossipore near Calcutta," but this is undoubtedly an error for Cossipore is on the banks of the River Hughli, and fully ninety miles away from the sea, there is soft mud on the fore-shore, and no sand at all. The locality has no resemblance whatever to Karachi. Moreover, *C. copulata* has never again been recorded from near Calcutta, while it has often turned up at Karachi. It is thus safe to assume that it does not occur in the former locality. The species is generally found in open sandy places. Fleutiaux (1917) records what he considered this species from Annam, but in a later paper (1919) he showed that it was really *C. punctatissima* Schaum.

Cicindela quadrilineata, Fabr. In recording this form and *C. biramosa* Fabr., from Chandipore on the Orissa sea-coast Dr. Gravely (1919, p. 398) remarks: "*Cicindela quadrilineata*, Fabricius is sometimes to be found where the ground is muddy. In 1919 it was comparatively abundant on muddy sand at the mouth of the Burhabalang River. Both species are common seashore insects, living near high-tide mark, but I am not aware that they have been found so closely associated before. In Annandale and Horn's Annotated List of Indian Museum Cicindelinae (Calcutta, 1909), *C. biramosa* is recorded from various places from N. Kanara on the Malabar coast to Java, and *C. quadrilineata* from Burma and Bengal to south of Madras; and the known range of the latter species is extended in the 'Fauna of British India' to Sind and Baluchistan. More recent observations both by Dr. Annandale and myself suggest that *C. biramosa* is the common seashore species of the east and southwest coasts of the Indian Peninsula, and that *C. quadrilineata* holds this position on the northern parts of the west coast. Mr. Kemp found both on the coast of Portuguese India." In a fortnight's visit to Chandipore in the latter half of September, 1920, we did not see either of these species, but *C. limosa*, Saund., was occasionally observed in the burrows of the crab, *Ocypoda macrocera*, Milne-Edwards, a brilliant red species of considerable size, very common on the beach. The beetle probably only goes into the burrow for shelter and the case must not be taken as one of commensalism. A damaged example of *limosa* has been taken by Gravely from the nest of a gregarious spider (*Stegodyphus*) at Durgapur, Salt Lakes, near Calcutta. The variety *renei*, Horn, of *C. quadrilineata* has been taken by Kemp at Pamben in the Gulf of Manaar (24.II.13.)

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XXXII REMARKS ON A SPECIMEN OF *CALAMARIA JAVANICA*.

By COLONEL F. WALL, I.M.S.

I have recently examined an example of the genus *Calamaria* belonging to the collection of the Zoological Survey of India. As this specimen is a valuable one, the following notes on it should I think be placed on record.

The specimen (No. 4450) was referred by Sclater (*List Snakes Ind. Mus.* 1891) to *Calamaria pavementata*. I am of opinion that it should be referred to *C. javanica*.

It was obtained from Johore in the Malay Peninsula, and measured 142 mm. ($5\frac{5}{8}$ inches).

Lepidosis. *Rostral*.—Touching four shields, the rostro-prae-frontal sutures longer than the rostro-labials. Portion visible above a shade less than its distance to the frontal. *Internals*.—Wanting. *Praefrontals*.—Length greater than the frontal, touching the rostral, 1st and 2nd supralabials, eye and supraocular. *Frontal*.—As long as the snout, half the parietals, equal to its breadth. *Supraoculars*.—Length one-third the frontal, breadth one-fifth the frontal. *Nasal*.—Very small. *Loreal*.—None. *Prae-ocular*.—None. *Postocular*.—None. *Supralabials*.—Four, the 3rd very short, the 4th longer than the 2nd and 3rd taken together, two-thirds the parietals; 2nd and 3rd touching the eye. *Sublinguals*.—Posterior, not separated, touching the 3rd and 4th infralabials. *Infralabials*.—The 1st in contact behind the mental; 4th largest, length three-fourths the posterior sublinguals, breadth equal to those shields. *Costals*.—In 13 rows in the whole body length, the ultimate row not enlarged, smooth. *Ventrals*.—187. *Anal*.—Entire. *Subcaudals*.—15, entire.

Tail compressed basally. Eye about one-third the length of the snout, less than its distance to the edge of the lip. Uniform light brown dorsally and ventrally, the costals with rather lighter edges. No head marks, nor tail marks.

XXXIII. ON SOME NEW OR RARE SPECIES
OF FISH FROM THE EASTERN
HIMALAYAS

By SUNDER LAL HORA, M.Sc., Assistant Superintendent,
Zoological Survey of India.

(Plate XXIX.)

The fish on which the following notes are based formed part of a collection recently made by Mr. G. E. Shaw in the foot-hills of the Eastern Himalayas below Darjiling. Mr. Shaw has taken great pains to make his collection of the fishes of this area complete and I am greatly indebted to him for the opportunity of examining it. Among the specimens I have found examples of *Psilorhynchus sucatio* and *Erethistes clongata* which were hitherto known only from the original descriptions of Hamilton Buchanan and Day, while there are three species which appear to be new. Mr. Shaw has very kindly presented specimens of the species he collected to the collection of the Zoological Survey of India.

***Psilorhynchus sucatio* (Ham. Buch.).**

(Pl. XXIX, figs. 1, 1a.)

1822. *Cyprinus sucatio*, Hamilton Buchanan, *Fish. Ganges*, pp. 347 and 393.
1839. *Psilorhynchus sucatio*, McClelland, *Asiatic Res.* XIX pp. 300 and 428, pl. 50, figs. 1 and 1a. [343.
1868. *Psilorhynchus sucatio*, Günther, *Faun. Brit. Ind. Fish.* VII, p.
1871. *Psilorhynchus sucatio*, Day, *Journ. As. Soc. Bengal* XL, p. 107, pl. ix, fig. 1.

This species has hitherto been known only from Hamilton Buchanan's description published in 1822 and from the manuscript drawing preserved in the library of the Asiatic Society of Bengal. In 1871 Day, in the work cited above, remarked: "it does not appear at all impossible that the other, *P. sucatio*, H. Buch., may be destitute of an air-bladder and would thus form a distinct genus appertaining to the subfamily Homalopterinae," but in his later work¹ he suggested that it was synonymous with *Homaloptera bilineata*.

I have found three specimens in Mr. Shaw's collection which agree with the description and figure of Hamilton Buchanan's *Cyprinus sucatio*. The species possesses a fairly well-developed bladder of the cyprinid type and is destitute of barbels. In its

¹ Day, *Fish India* II p. 526 (1878).

elongate snout it closely resembles certain species of the genus *Homaloptera*, but it can be readily distinguished by the absence of barbels and by the presence of a free air-bladder in the abdominal cavity.

Buchanan found the species in "the rivers of Northern Bengal," while his second species, *P. balitora*, was "found in the rivers towards the north-east of Bengal." McClelland (*op. cit.*), who had examined only a single specimen of *P. balitora* forwarded to him from "Upper Assam" by Capt. Hannay, gave the habitat of both the species as "north-eastern parts of Bengal." Günther (*op. cit.*) who followed McClelland made the same mistake. The specimens of *P. balitora* in our collection enable me to confirm Buchanan's statement that the species occurs in the Khasi Hills (north-east of Bengal), while *P. sucatio* is found at the base of the Darjiling Himalayas (Northern Bengal). I¹ referred some young specimens collected by Dr. Annandale at Siliguri in the Mahanadi River to *P. balitora*, but on further examination I find that they are the young of *P. sucatio*. The mistake was due to the immaturity of the specimens.

The genus *Psilorhynchus* comprises three Indian species, one of which was recently described by myself (*op. cit.*, p. 208) from immature specimens found in the Naga Hills. The new species is readily distinguished from those previously known by its straight profile, by the absence of any grooves on the under surface of the head and by the position of the eye, which is considerably nearer to the tip of the snout than to the posterior limit of the operculum. *P. sucatio* differs from *P. balitora* in possessing a long depressed snout and a greatly elevated back fin.

Annandale² described a species of fish from the Bombay Presidency under this genus, but quite recently I³ have referred it to a separate genus for which I have proposed the name *Parapsilorhynchus*.

In *Psilorhynchus sucatio* the dorsal profile is greatly arched. It is highest near the base of the dorsal fin, whence it slopes considerably towards both ends. The ventral profile is only slightly arched. The caudal peduncle is narrow and elongated. The head is much depressed and both the upper and the lower surfaces are greatly flattened; it is one and a quarter times as long as broad. The length of the head is contained about 5 times in the length of the body excluding the caudal fin. The depth of the body in full grown specimens is slightly less than the length of the head and is contained 5.5 times in the length of the body. The snout is broad and evenly rounded; the interorbital space is somewhat concave. The eyes are large and globular and are situated in the posterior half of the head; they are only slightly visible from below. The diameter of the eye is contained almost

¹ Hora, *Rec. Ind. Mus.* XIX, p. 210 (1920).

² Annandale, *Rec. Ind. Mus.* XVI, p. 128 (1919).

³ Hora, *Rec. Ind. Mus.* XIX, p. 209 (1920).

3 times in the length of the head and the snout is 1.5 times the diameter of the eye in length. The interorbital width is greater than the diameter of the eye. The mouth is situated on the under surface of the head considerably behind the tip of the snout and is bordered by thick lips. The lower lip and the skin immediately behind it is somewhat papillated. There are two curved grooves running from the angle of the mouth to the tip of the snout. The nostrils are situated considerably nearer to the eye than to the tip of the snout.

The dorsal fin commences in advance of the ventrals, and its origin is much nearer to the tip of the snout than to the base of the caudal fin; its free margin is truncate and oblique. The longest ray of the dorsal fin is considerably higher than the depth of the body below it; its shortest ray equals the longest ray of the anal fin in length. There are two spines and 7 or 8 branched rays in the dorsal fin. The pectoral fins are greatly expanded and are horizontally placed. They contain 13 or 14 rays, of which the first four are not branched. It is separated from the base of the ventral fins by half its own length. The ventrals are only slightly shorter than the pectorals, they are expanded and horizontally placed. They contain 9 or 10 rays, of which the first two are not branched. The ventrals extend considerably beyond the anal opening. The anal fin is short and rounded and is placed nearer to the base of the caudal than to that of the ventral fin. It contains seven rays, of which five are branched. The caudal fin is as long as the length of the head and is deeply forked. Both the lobes are pointed; the upper is slightly longer than the lower.

The lepidosis is quite normal except on the chest, where the scales are either absent or greatly reduced. There are 38 scales along the lateral line from the angle of the operculum to the base of the caudal fin, and six series of longitudinal rows of scales between the bases of the dorsal and the ventral fins. A scale from near the base of the dorsal fin is semicircular in outline with an almost flat base and an arched apex. The nucleus is eccentric and is situated close to the base. There are about 5 or 6 radii to the apex and the circular striae are indefinite and closely packed together.

The air-bladder has undergone a certain amount of degeneration from the normal cyprinid type. The anterior chamber is laterally flattened and covered with a thick fibrous coat. The posterior chamber is narrow and elongated and is of uniform thickness throughout; its walls are greatly thickened. It is displaced from its original position and comes to lie on one side of the anterior chamber.

Hamilton Buchanan describes the colour of the species as follows: "Above the *colour* is greenish, with scattered dots; on the sides these are collected into clouds, and below the body is whitish and diaphanous. The fins of the back, breast and tail, are dotted. The eyes are brown, with a narrow golden circle round the pupil." The specimens before me possess five broad,

clouded vertical bands on the body and a number of stripes on the caudal fin. The membranes between the first few rays of the dorsal fin are black, and here and there are a number of black patches on the head and on the body. The under surface of the head and body are pale white.

Locality.—*Psilorhynchus sucatio* is found in rapids at the base of the Darjiling Himalayas. Four young specimens were collected by Dr. Annandale in the Mahanadi River at Siliguri (alt. 200 ft.) Mr. Shaw's specimens are from the Mahanadi River and the Sivoke River of the Darjiling District.

Measurements in millimetres.

	A.	B.	C.
Total length of body (excluding caudal)	69.7	55.5	51.2
Length of head	15.0	12.0	10.5
Width „ „	10.2	9.2	8.0
Depth of body	13.2	12.8	11.6
Diameter of eye	4.5	4.3	3.5
Length of snout	7.7	5.6	5.0
Interorbital width	6.9	4.8	4.3
Length of caudal peduncle	12.7	7.8	6.2
Least height of caudal peduncle	5.0	4.8	4.2
Distance from tip of snout to anterior origin of dorsal fin	30.0	26.5	24.2
Distance from base of caudal fin to anterior origin of dorsal fin	39.7	29.7	27.0
Distance from tip of snout to anal opening	38.0	32.6	30.8
„ „ base of caudal fin to anal opening	31.0	22.9	20.4
Longest ray of dorsal	17.4	11.6	11.2
„ „ „ anal	9.8	8.8	8.3
Length of pectoral fin	14.0	13.5	12.3
„ „ ventral „	12.2	12.0	10.2

***Oreinus molesworthi*, Chaudhuri.**

1913. *Oreinus molesworthi*, Chaudhuri, *Rec. Ind. Mus.* VIII, p. 243, pl. vii, figs. 2, 2a, 2b.

This species was described by Chaudhuri (*op. cit.*) from a single specimen from Yembung at an altitude of 1100 ft. in the Abor Hills. There is one specimen in Mr. Shaw's collection which I refer to this species after having compared it with the type-specimen and with the description and figures given by Chaudhuri.

Chaudhuri says that "the width of the mouth is nearly two and a half times the length of the head." Probably he meant to say that the width of the mouth was contained nearly two and a half times in the length of the head; this is very nearly correct. I find that the so-called scaleless portion of the body, which is situated behind the opercle and below the lateral line, possesses rudimentary scales which in the type-specimen are mostly hidden by the slime of the skin. In the specimen from the Darjiling Himalayas, which is 185 mm. in length including the caudal, there are only a few small conical warts on the snout and the body is comparatively less deep. The caudal fin is deeply forked with both the lobes pointed, the upper longer than the lower.

Mr. Shaw collected his specimen in the Reang River at an altitude of 2000 ft. in the Darjiling District.

***Aborichthys elongatus*, sp. nov.**

This species is represented in Mr. Shaw's collection by three specimens, two of which are young and one adult in a bad state of preservation. It can, however, be readily distinguished from the only other known species of the genus, *Aborichthys kempi*, Chaudhuri,¹ in the points tabulated below :—

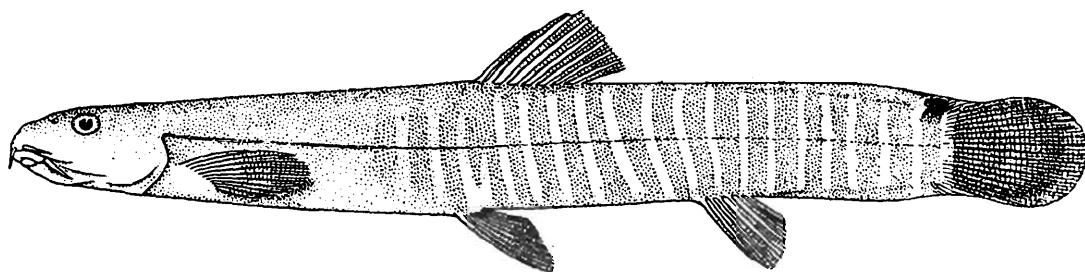
A. kempi, Chaudhuri.

1. The snout is a little shorter than the post-orbital part of the head.
2. There are 7 branched rays in the dorsal fin.
3. The dorsal is equidistant between the tubular nostrils and the root of the caudal.

A. elongatus, sp. nov.

The snout is almost equal to the post-orbital part of the head.
There are only six branched rays in the dorsal fin.
The dorsal is equidistant from the tip of the snout and the base of the caudal fin in the adult specimen; in younger specimens it is somewhat nearer to the tip of the snout than to the base of the caudal.

Besides these points the proportions and the colouration are totally different in the two species.



Lateral view of *Aborichthys elongatus*, sp. nov. Slightly enlarged.

A. elongatus is greatly elongated and compressed from side to side. Both the dorsal and the ventral profiles are straight and horizontal behind the pectoral fins and run almost parallel to each other to the base of the caudal fin. The head is rounded and cylindrical; its length is contained 6.1 times, the depth of the body 8.6 times and the length of the caudal fin 6.5 times in the total length including that of the caudal fin. The eyes are situated on the dorsal side in the middle of the head and are not visible from below; their diameter is contained 7.6 times in the length of the head and 3.2 times in that of the snout. The mouth is situated on the under surface a short distance behind the tip of the snout and is bordered with thick lips; the lower lip is interrupted in the middle. The lips are not fringed. The nostrils are close together and are situated nearer to the eye than to the tip of the snout; the membranous fold between the two is produced into a barbel-like outgrowth on either side. The dorsal fin commences

¹ Chaudhuri, *Rec. Ind. Mus.* VIII, p. 245, pl. vii, figs. 1, 1a, 1b (1913).

behind the ventrals and its origin is almost equidistant from the tip of the snout and the base of the caudal fin; it contains six branched rays besides two unbranched rays anteriorly. The pectorals are shorter than the head and are separated from the ventrals by a distance equal to their length. The ventrals extend considerably beyond the vent and are separated from the anal by a considerable distance. The anal fin is likewise short and contains six rays. It is separated from the root of the caudal fin by a distance almost equal to its length. The caudal fin is slightly shorter than the length of the head and its free posterior border is convex. The caudal peduncle is long and broad; it is 1.7 times as long as high.

Colour.—The sides and the upper surface of the head and body in front of the dorsal fin are dusky, while the under surface in the same region is either white or dull pale-olivaceous. From behind the origin of the dorsal fin to the base of the caudal fin the body is marked by a number of broad black bands alternating with narrow bands of a yellowish-orange colour. The bands form almost complete rings with slight interruptions on the extreme dorsal and the ventral sides. The pectoral, ventral and the anal fins are dull white while the dorsal fin is streaked with black along the rays. The caudal fin is dusky with a whitish margin. In the middle of the fin there are two short whitish bands. There is an intensely black ocellus at the upper corner of the root of the caudal fin.

In young specimens the bands on the body extend forward to the middle of the pectoral fins. The caudal fin is marked by a number of black blotches forming three bands.

Type-specimen.—F10087/1, *Zool. Surv. Ind. (Ind. Mus.)*

Locality.—Two young specimens and one adult were collected by Mr. Shaw in the Reang River at an altitude of 2000 ft. in the Darjiling District. The only other species of the genus, *A. kempfi*, has been recorded from the Abor country, the Garo Hills and the Putao Plains in Upper Burma.¹

Measurements in millimetres.

Total length excluding caudal fin	...	...	...	74
Length of caudal fin	...	...	...	13
Depth of body	...	...	...	9.8
Length of head	...	...	...	13.6
" " snout	...	...	...	6
Diameter of eye	...	...	...	1.8
Length of pectoral fin	...	...	...	11.2
" " ventral "	...	...	...	9.5
Longest ray of anal fin	...	...	...	9.0
" " " dorsal "	...	...	...	6.8

Macrones (*Macronoides*) *merianiensis*, Chaudhuri.

1913. *Macrones merianiensis*, Chaudhuri, *Rec. Ind. Mus.* VIII, p. 253, pl. ix, figs. 1, 1a, 1b.

¹ Chaudhuri, *Rec. Ind. Mus.* XVI, p. 278 (1919).

This interesting species has so far been known from a single specimen in our collection found in a pond at Mariani junction, Assam. In Mr. Shaw's collection there are three specimens from the Sivoke River (alt. 500 ft.) in the Darjiling District, which agree in almost all respects with Chaudhuri's description of the species. They are 70, 60 and 56 millimetres in length respectively.

Quite recently¹ I have separated this species along with *Macrones affinis* (Blyth)² and *M. dayi*, Vinciguerra,³ into a distinct subgenus *Macronoides*. The fishes of this subgenus are readily distinguished by their short barbels which do not exceed the length of the head, by the possession of pores on the under surface of the head and by the fact that the mandibular pairs of barbels are placed in an almost horizontal line.

Macrones marianiensis is known from the Abor Hills and the base of the Darjiling Himalayas.

*Olyra kemp*i, Chaudhuri.

1912. *Olyra kemp*i, Chaudhuri, *Rec. Ind. Mus.* VII, p. 443, pl. xl, figs. 4, 4a, 4b.

Chaudhuri (*op. cit.*) described this species from five young specimens; the largest measuring 54 mm., which were collected by Dr. S. W. Kemp in the Darrang District (Assam-Bhutan Frontier). There is one specimen in Mr. Shaw's collection which measures 78 mm. in length and which closely resembles the type-series except in colour. The Darjiling example is dusky with a black caudal fin. The under surface of the head is pale olivaceous while the belly is white. The longitudinal stripes on the body, which Chaudhuri described, are lacking.

In the specimen both the pectoral spines are broken which shows that the fish is regarded as poisonous by the local fishermen.

The species closely resembles *Olyra longicauda*, McClell., but in the absence of specimens from the Khasi Hills, it is impossible to make a detailed comparison between the two forms. They can, however, be distinguished by the number of rays in the anal fin. In *O. longicauda* there are said to be 23, while in *O. kemp*i there are only 17-19.

Mr. Shaw collected his specimen in the Sivoke River at an altitude of 500 ft. at the base of the Darjiling Himalayas. This is only the second record of this genus from the Eastern Himalayas.

Pseudecheneis sulcatus (McClell.).

1842. *Glyptosternon sulcatus*, McClelland, *Calcutta Journ. Nat. Hist.* II, p. 587, figs. 1, 2 and 3.

¹ Hora, *Rec. Ind. Mus.* XXII, pp. 179, 180 (1921).

² Blyth, *Journ. As. Soc. Bengal* XXIX, p. 150 (1860).

³ Vinciguerra, *Ann. Mus. civ. Stor. Nat. Genova* XXIX, p. 230, pl. vii, fig. 3 (1889).

1860. *Pseudecheneis sulcatus*, Blyth, *Journ. As. Soc. Bengal* XXIX, p. 154.
 1919. *Pseudecheneis sulcatus*, Chaudhuri, *Rec. Ind. Mus.* XVI, p. 278 (see references).

Of all the hill-stream fishes with which I am personally acquainted, this species has the widest range. McClelland (*op. cit.*) described it for the first time from the "Kasyah mountains." Day¹ recorded it from the Darjiling District and Chaudhuri² extended its range to the Abor Hills. Vinciguerra³ found some specimens of this species in Fea's collection from Khakhyen (Kachin) Hills and Chaudhuri (*op. cit.*) has recently recorded it from Upper Burma. It is interesting to find that a fish so highly specialized for life in rapid running waters should be distributed over so wide an area.

The only specimen in Mr. Shaw's collection measures 75 mm. including the caudal fin. It was procured by him in the Reang River at an altitude of 2000 ft. in the Darjiling District.

Amblyceps mangois (Ham. Buch.).

1919. *Amblyceps mangois*, Chaudhuri, *Rec. Ind. Mus.* XVI, p. 275 (see references).

There is only one specimen of this species from the Sivoke River (alt. 500 ft.) in the Darjiling District. It measures 68 mm. in length without the caudal fin and is a ripe female. The eggs are large and I have been able to count about 36 in this specimen. The diameter of the mature egg was found to be 2.2 mm.

This species is widely distributed in the fresh waters of Northern India and Burma and usually occurs along the bases of the hills.

Erethistes elongata (Day).

1871. *Hara elongata*, Day, *Proc. Zool. Soc. London*, p. 704.
 1878. *Erethistes elongata*, Day, *Fish. Ind.* II, p. 453, pl. cii, fig. 5.
 1889. *Erethistes elongata*, Day, *Faun. Brit. Ind. Fish.* I, p. 207.

Erethistes elongata has hitherto been known from a single specimen found in "a stream near the Garraw Hills." Day in his later works gives the Naga Hills, probably in error. Mr. Shaw's example was procured in the Mahanadi River near Siliguri, at the base of the Darjiling Himalayas; it is 50 mm. in length without the caudal fin and is longer than the type-specimen figured by Day. I give below the measurements of the two specimens for comparison.

Measurements in millimetres.

		A (type).	B.
Total length of body (excluding caudal)	...	45.0	50.2
Length of head	...	9.5	9.6
Width „ „	...	7.0	7.8

¹ Day, *Fish. Ind.*, II, p. 500, pl. cxvi, fig. 1 (1878); *Faun. Brit. Ind. Fish.* I, p. 107, fig. 44 (1889).

² Chaudhuri, *Rec. Ind. Mus.* VIII, p. 255 (1913).

³ Vinciguerra, *Ann. Mus. civ. Stor. Nat. Genova* XXIX, p. 252 (1889-90).

	A (type).	B.
Depth of body	6.7	7.8
Diameter of eye	1.3	1.3
Length of snout	5.0	5.6
Interorbital width	3.2	3.7
Length of caudal peduncle	10.8	13.5
Least height of caudal peduncle	2.7	2.2
Distance from tip of snout to anterior origin of dorsal fin	17.0	18.2
Distance from base of caudal fin to anterior origin of dorsal fin	28.5	32.0
Distance from tip of snout to anal opening	24.0	26.8
Distance from base of caudal fin to anal opening	21.5	23.4
Length of dorsal spine	11.2	13.5
" " pectoral spine	11.6	12.8
Length of ventral fin	6.8	7.0
" " anal fin	7.0	8.0

Erethistes elongata is abundantly distinct from the remaining species of this genus and is easily recognised by its elongate form and short scapular processes. It also possesses a well-marked tubercle in the middle of the upper jaw. In other species of the genus the scapular processes are long and the skin covering the belly is smooth, but in *E. elongata* the scapular processes are short and the skin on the under surface is thrown into grooves and ridges. These longitudinal folds of skin extend from between the bases of the pectoral fins to the ventrals; they appear to have a definite biological significance, and are probably used by the fish in adhering to rocks and stones in rapid running waters.

The fish is black in colour throughout with the exception of the chest, which is dirty white. The fins are marked with white bands.

Laguvia, gen. nov.

The genus *Laguvia* may be characterized as follows:—

The head and body are slightly depressed and the skin covering the belly is corrugated, suggesting an adherent function. The pectoral fins are provided with strong denticulated spines; the dorsal spine is strong and bony and may or may not be serrated anteriorly. The adipose dorsal is short but well marked. The mouth is subterminal and is surrounded by thick lips. There are eight barbels, one pair of nasal, one pair of maxillary and two pairs of mandibular. The nostrils are situated close together and are separated by a flap bearing the nasal barbel. The gill-openings are wide and almost meet each other in the middle on the under surface. The occipital and cubito-humeral process are present. There is a short scapular process which may or may not be followed by bony tubercles posteriorly. The eyes are minute and are situated on the dorsal surface of the head. The air-bladder is divided into two lateral chambers which are not enclosed in bone.

The new genus comprises small fish inhabiting rapid running waters at the base of mountains. It closely resembles *Erethistes*, Müll. and Trosch., from which it can be readily distinguished by the nature of its gill-openings which are very wide. From the genus *Glyptothorax* it differs in the possession of scapular, pro-

cesses, the presence of free bony tubercles on the sides of the body and in the absence of a well-marked adhesive apparatus on the chest. In most respects the genus is intermediate between *Erethistes* and *Glyptothorax*.

I refer to this genus *Pimelodus asperus*, McClell.,¹ besides two new species from the base of the Darjiling Himalayas described below. McClelland's species was described from Chusan in China ; it has been referred to the genus *Hara*, Blyth, both by Günther² and Bleeker,³ while Chaudhuri⁴ has quite recently recorded it as *Erethistes asperus* from Upper Burma (N. Frontier).

***Laguvia shawi*, sp. nov.**

(Pl. XXIX, fig. 2).

This species comprises small subcylindrical fish in which the head is slightly depressed and the body arched both above and below. The dorsal profile rises considerably from the tip of the snout to the base of the dorsal, beyond which it slopes down to the root of the caudal. The belly bulges somewhat downwards. The head is long and broad ; its length is contained about 3·3 times in the length of the fish without the caudal fin. It is 1·2 times as long as broad. The snout is broad and almost semicircular in outline ; it is as long as the post-orbital part of the head. The eyes are minute and are situated on the dorsal surface of the head in the middle ; they are not visible from below. The mouth is a wide transverse slit on the under surface of the head a short distance behind the tip of the snout. The nostrils are situated close together and are separated from each other by a membranous flap bearing the nasal barbel ; they are situated at an equal distance from the tip of the snout and the anterior margin of the eye. There are eight barbels ; those of the maxillary pair are broad at their bases and reach the bases of the pectoral fins. The outer mandibular barbels are longer than the inner and are slightly shorter than the maxillary barbels. The nasal barbels are as long as the distance between the nostrils and the middle of the eye ; they are short and thin and are apt to be overlooked. The dorsal fin commences greatly in advance of the ventrals and its origin is much nearer to the tip of the snout than to the base of the caudal fin ; its first divided ray is the longest but is not so high as the depth of the body below it, it contains 5 or 6 branched rays and two spines anteriorly. The dorsal spine is strong and bony ; it is smooth anteriorly but somewhat roughened posteriorly. The pectoral fin is almost as long as the head and is provided with a strong spine which is serrated externally but internally it possesses about 7 hooked spines. The ventrals are not

¹ McClelland, *Calcutta Journ. Nat. Hist.* IV, p. 404, pl. xxiv, fig. 2 (1844).

² Günther, *Cat. Brit. Mus. Fish.* V, p. 189 (1864).

³ Bleeker, *Ned. Tijdschr. Dierk.* IV p. 105 (1873).

⁴ Chaudhuri, *Rec. Ind. Mus.* XVI, p. 276, pl. xxii, figs. 2, 2a, 2b.

separated from the pectorals by any great distance; their origin is distinctly nearer to the root of the caudal fin than to the tip of the snout. The ventrals almost reach the base of the anal fin which contains 9 rays, the anteriormost of which is not branched. The caudal fin is long and its free posterior border is almost semi-circular; the two extremities are sharp and pointed.

The air-bladder has receded inwards towards the vertebral column and consists of two chambers, one on either side of the basioccipital process of the skull. The occipital, cubito-humeral and the scapular processes are finely tuberculated and there is a bony nodule covered by skin below the base of the dorsal spine.

Colour.—The sides and dorsal surface of the head are black; the ventral surface is dull white. The general colouration of the body is pale yellow, but the sides are marked with two broad black bands formed by an aggregation of black dots. The anterior band is below the bases of the anterior dorsal fins and the posterior band is situated below the bases of the adipose dorsal and the anal fins. The fins are indistinctly marked with black bands.

Type-specimen.—F 10085/1, *Zool. Surv. Ind. (Ind Mus.)*.

Locality.—There are three specimens in Mr. Shaw's collection, two from the Mahanadi River and one from the Sivoke River. Both these rivers flow at a very low altitude at the base of the Darjiling Himalayas.

Measurements in millimetres.

Total length including caudal fin	...	...	...	30.0
Length of caudal fin	...	...	...	5.4
Depth of body	...	...	...	5.0
Length of head	...	...	...	8.0
Width " "	...	...	...	6.5
Length of snout	...	...	...	4.0
Interorbital width	..	...	...	2.5
Height of dorsal spine	...	...	...	4.2
Length of pectoral spine	...	...	...	5.5

One of the specimens on dissection was found to be full of eggs. The eggs are small in this species.

Laguvia ribeiroi, sp. nov.

Pl. XXIX, fig. 3.

This species differs from the preceding in several respects and was obtained by Mr. Ribeiro in an adjacent locality. The following table shows some of the salient points in which the two species differ:—

<i>L. shawi</i> , sp. nov.	<i>L. ribeiroi</i> , sp. nov.
1. The nostrils are equidistant from the tip of the snout and the anterior margin of the eye.	The nostrils are nearer to the tip of the snout than to the anterior margin of the eye.
2. The origin of the ventral fin is distinctly nearer to the base of the caudal than to the tip of the snout.	The origin of the ventral fin is almost equidistant from the tip of the snout and the base of the caudal fin.

- | | |
|--|--|
| 3. The dorsal spine is almost smooth along both the borders. | The dorsal spine is finely serrated along the whole of its anterior border and also along the upper one-third of the posterior border. |
| 4. The skin covering the belly is smooth. | The skin covering the belly is corrugated to form a kind of rudimentary adhesive apparatus. |

Besides these points the two species differ in proportions and colouration. Moreover the eggs of *L. shawi* are minute whereas those of *L. ribeiroi* are much larger.

L. ribeiroi is a small subcylindrical fish with the head and body slightly depressed. The dorsal profile rises gradually from the tip of the snout to the base of the dorsal fin, beyond which it falls to the root of the caudal fin. The ventral profile is somewhat arched. The head is short and broad; its length is contained about 3.7 times in the length of the fish without the caudal fin. The eyes are minute and are situated almost in the middle of the head on the dorsal surface; they are not visible from below. The mouth is situated on the under surface slightly behind the tip of the snout and is bordered by moderately thick lips. The nostrils are situated close together, they are nearer to the tip of the snout than to the anterior margin of the eye. The gill-openings are very wide. There are 8 barbels, the maxillary barbels are provided with broad bases and do not reach the base of the pectoral fins. The skin covering the belly is thrown into oblique grooves and ridges which form a V-shaped adhesive apparatus similar to that found in the genus *Glyptothorax* but not so well-developed. The dorsal fin commences somewhat in advance of the ventrals and its origin is much nearer to the tip of the snout than to the root of the caudal fin; it is provided with a strong spine and six rays. The dorsal spine is not so high as the depth of the body below it; it is serrated along the whole of its anterior border and along the upper part of its posterior border. The pectoral is slightly shorter than the head and is separated from the ventrals by a short distance. The pectoral spine is flat and strong; externally it is serrated but internally it is provided with eight curved spines. The ventrals just extend beyond the anus but do not reach the base of the anal fin which contains 10 rays. The caudal fin is long and its free posterior border is semi-circular; the two extremities are sharply pointed, the lower is slightly longer than the upper.

The scapular process is small and there are a number of bony tubercles behind the gill-opening in a horizontal line. The bones of the head and the various processes are slightly corrugated but not distinctly tuberculate.

Colour.—The sides and the dorsal surface of the head and body are dark; the ventral surface is dull white, speckled with black dots. There are two broad yellowish bands on the body; the anterior is between the rayed dorsal and the adipose dorsal fins and the second is below the posterior half of the base of the

adipose fin. The adipose dorsal is dusky, while the other fins are distinctly banded.

Type-specimen.—F 10086/1, *Zool. Surv. Ind. (Ind. Mus.)*.

Locality.—There is a single specimen collected by Mr. Ribeiro in the Khoila River, a tributary of the Tista at Jalpaiguri in the Darjiling District.

Measurements in millimetres.

Total length including caudal	...	...	...	31.5
Length of caudal fin	...	...	...	6.4
Depth of body	...	...	...	5.8
Length of head	...	...	...	7.5
Width „ „	...	...	...	6.5
Length of snout	...	...	...	3.6
Interorbital width	...	...	...	2.5
Height of dorsal spine	...	...	...	5.3
Length of pectoral spine	...	...	...	6.5

The specimen is a female and was found on dissection to be full of eggs. The eggs are large; the longest diameter being 1.4 mm.

Besides the ten species of fish discussed in the foregoing pages the following species were also represented in Mr. Shaw's collection :—

Callichrous pabda (Ham. Buch.).
Macrones vittatus, Bloch.
Pseudentropius murius (Ham. Buch.).
Garra gotyla (Gray).
Garra annandalei, Hora.
Semiplotus semiplotus (McClell.).
Barbus stigma (Ham. Buch.).
Barbus conchoni (Ham. Buch.).
Danio aequipinnatus (McClell.).
Danio rerio (Ham. Buch.).
Rasbora daniconius (Ham. Buch.).
Nemachilus botius (Ham. Buch.).
Nemachilus multifasciatus, Day.
Lepidocephalichthys guntea (Ham. Buch.).
Ophiocephalus gachua (Ham. Buch.).
Glossogobius giuris (Ham. Buch.).
Dorichthys deocata (Ham. Buch.).

In addition there are some specimens of the genus *Nemachilus* which I have not been able to refer to any known species.

Quite recently Dr. Murray Stuart of the Geological Survey of India has brought back a small collection of fish from the North-Eastern border of Burma and the Naga Hills. He has very kindly presented this collection to the Indian Museum. I have been able to identify the following fish in this collection :—

Garra gotyla (Gray).
Crossochilus latia (Ham. Buch.).
Barbus clavatus (McClell.).

- Barbus ticto* (Ham. Buch.).
Barbus conchoni (Ham. Buch.).
Barbus chrysopterus (McClell.).
Danio aequipinnatus (McClell.).
Rasbora rasbora (Ham. Buch.).
Barilius vagra (Ham. Buch.).
Nemachilus botius (Ham. Buch.).
Ambassis nama (Ham. Buch.).
-

EXPLANATION OF PLATE XXIX.

Fish from the Eastern Himalayas.

- FIG. 1.—Lateral view of *Psilorhynchus sucatio* (Ham. Buch.).
× 2.
,, 1a.—Under surface of head and chest of same. × 2.
,, 2 —Lateral view of *Laguvia shawi*, sp. nov. × 3.
,, 3.—Lateral view of *Laguvia ribeiroi*, sp. nov. × 3.

XXXIV OLIGOCHAETA FROM MANIPUR, THE LACCADIVE ISLANDS, MYSORE, AND OTHER PARTS OF INDIA.

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(Plate XXVIII).

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INTRODUCTION.

The present paper deals with Oligochaeta received from the three following sources :—

(1) The majority of the specimens were received from the Indian Museum, and a large number of these were brought from Manipur by the Manipur Survey Party; others are from the Nilgiris in S. India, and a few from other parts.

(2) I received a small collection from Mr. R H. Whitehouse, Marine Biologist to the Madras Fisheries Department, obtained from the Laccadive Islands during a recent visit by one of his assistants.

(3) A tube of specimens, collected in May, 1920 in the forests of Shimoga and Kadur Districts, Mysore, which contained three interesting species, two of which are new, was forwarded to me, at the suggestion of Prof. J. P. Hill, by Mr. A. Subba Rau, a student of University College, London.

To the Director of the Zoological Survey, and to the other gentlemen named, I am much indebted for the opportunity of examining these collections. I propose to offer a few general remarks on them before passing to the systematic description.

Distribution of the species investigated.

The species are distributed as follows:---

Manipur	<i>Branchiura sowerbyi</i> , Bedd. <i>Pheretima hawayana</i> (Rosa). <i>Pheretima heterochaeta</i> (Mich.). <i>Perionyx excavatus</i> , E. Perrier. <i>Eutyphoeus manipurensis</i> , sp. nov.
Madras Pres. :—	
Madras City	<i>Branchiodrilus menoni</i> , Steph. <i>Branchiura sowerbyi</i> , Bedd.
Nilgiris	<i>Tubifex</i> (<i>Tubifex</i>) <i>tubifex</i> (O. F. M.). <i>Plutellus aquatilis</i> , sp. nov. <i>Pheretima heterochaeta</i> (Mich.). <i>Perionyx saltans</i> , Bourne. <i>Perionyx sansibaricus</i> , Mich..
Barkuda I.	<i>Nais paraguayensis</i> , Mich. var. <i>barkudensis</i> , nov. <i>Octochaetus barkudensis</i> , Steph.. <i>Eudichogaster barkudensis</i> , sp. nov.
Godaveri Dist.	<i>Megascolides annandalei</i> , sp. nov. <i>Megascolex mauritii</i> (Kinb.).
Mysore	<i>Drawida rawi</i> , sp. nov. <i>Perionyx mysorensis</i> , sp. nov. <i>Glyphidrilus annandalei</i> , Mich..
Central Provinces	<i>Nais paraguayensis</i> , Mich.. <i>Branchiodrilus</i> sp. <i>Aulodrilus remex</i> , sp. nov.
Laccadive Islands.	<i>Megascolex mauritii</i> (Kinb.). <i>Megascolex konkanensis</i> , Fedarb.

The Oligochaeta of the Laccadive Islands.

The Laccadives are a group of coral islands, the nearest of which is about 150 miles from the Malabar Coast. The only previous account of the Oligochaeta of these islands is by Beddard,

on the basis of Gardiner's collections from the Maldives and Laccadives, made in 1899 and 1900 (1). Beddard received two species only from the Laccadives, both from Minikoi,—*Pontodrilus laccadivensis* (united by Michaelsen with *Pontodrilus bermudensis*, Bedd.), and *Megascolex mauritii* (Kinb.). In the present more extensive collection also only two species are found,—*Megascolex mauritii* (Kinb.) and *Megascolex konkanensis*, Fedarb.

Pontodrilus bermudensis, littoral in habit, as are all the species of the genus, has spread widely on the shores of tropical and subtropical seas all round the world. *Megascolex mauritii* is also in a special degree peregrine, it is very common in India, and inhabits also the lands bordering the Indian Ocean, and S. and S.E. Asia generally. *Megascolex konkanensis* is common on the Malabar coast,—i.e. that part of India which is nearest to the islands, and with which communication is most frequent.

It appears therefore that the earthworm fauna of the Laccadives, as was to be expected, is entirely introduced, and is very limited in the number of species.

The Indian Tubificidae.

Tubificids appear to be rare in India, and hitherto only four species have been recorded, belonging to as many genera:—*Branchiura sowerbyi*, Bedd., *Limnodrilus socialis*, Stph., *Bothrioneurum iris*, Bedd., and *Monopylephorus parvus*, Ditlevsen. The present communication brings a fresh record for *Branchiura sowerbyi* (from Manipur), and adds two more species to the Indian list,—*Tubifex* (T.) *tubifex* and a new *Aulodrilus*.

Branchiura sowerbyi, remarkable for its gills, was discovered first by Beddard in the mud of the Victoria regia tank in the Royal Botanical Society's Gardens in London in 1892, it was not seen again for sixteen years, when Michaelsen found it in a warm water tank of the Botanical Gardens at Hamburg; Southern then found specimens in the Victoria regia tank at Dublin, and Perrier in the Rhone; and in recent years a number of finds have been recorded by Keyl and Stephenson from warm houses in Europe, and from the open in India, Burma, China and Japan. Indeed it appears to be quite common in the East.

Tubifex (*Tubifex*) *tubifex* (O. F. M.), a widely spread European species, is now found in the Nilgiris, where it differs but slightly from the common form.

The genus *Aulodrilus* was established by Bretscher in 1899 (2) for *A. limnobiis*, found in Switzerland. Though he places it as an appendix to the Tubificidae, he recognizes that it fits in neither with that family nor with the Lumbriculidae, and suspects that it may be necessary to found a new family for it. The reproductive organs are still, as they were to Bretscher, unknown; but the genus is distinguished from most other Tubificidae by the fact that the needle setae (crotchets) have the upper tooth (the one on the outer side of the curve of the shaft) much smaller than

the other,—the reverse is the case in most other genera of the family.

A second species was described in 1906 by Piguet (10), who placed it among the Naididae as *Naidium pluriseta*, but later (11) transferred it to *Aulodrilus*.

The justification for the inclusion of these species in the Tubificidae is to be found in the absence of asexual reproduction by fission, which is a constant characteristic of the Naididae; as well as, perhaps, if *A. pluriseta* resembles *A. limnobius* and *A. remex*, in the presence of large parietal vascular loops at the hinder end of the body. It must however be owned that if, as Piguet states, an *Aulodrilus* from the S. of France, the study of which was not completed when he wrote, has retractile penes in front of the ventral setae of segment vii, the genus is probably nearer to the Naididae than to the Tubificidae, though capable of inclusion in neither; and Michaelsen's caution in placing *Aulodrilus* as a doubtful genus (of Tubificidae) (6) is justified.

A. limnobius and *A. pluriseta* form tubes, as does perhaps, to judge from the foreign matter which adhered to the present specimens the Indian species also. The hinder end of both *A. pluriseta* and the present species (and, it may be conjectured, *A. limnobius* also) is remarkable; the most posterior region shows no proliferation, nor even any segmentation; but there is a zone of proliferation and formation of numerous new segments some little distance *in front of* the anus. These zones are known in other worms in two situations;—terminal, in probably all Oligochaetes and other segmented worms which continue to produce new segments during their life; and in the middle of the body, in *Aeolosoma* and the Naididae, where such a production of new segments (a "budding zone") indicates the site of approaching fission. Such a budding zone as that of the present genus is, so far as I know, unique.

The terminal unsegmented region Piguet looks on as physiologically a gill; it possesses a rich cutaneous vascularization; and during life the anus can dilate, giving rise to a "branchial fossa."

Some interesting species in the collections.

Drawida rawi, sp. nov., described below is interesting from the fact that it possesses a well-developed pair of prostates in segment ix, equal in size to those in segment x. The anterior pair have no direct communication with the male reproductive apparatus, while the posterior are, as usual, joined by the vasa deferentia. Michaelsen has previously (7) found a rudimentary second pair in segment ix in *D. willsi*, and has argued that the genus originally possessed two fully-developed pairs, of which the anterior has disappeared. This anterior pair, in turn, is the index of a formerly existing second pair of testes, the ancestors of the genus *Drawida* having been holandric while their present-day representatives are metandric (retaining only the posterior of the two original pairs of testes). The genus *Desmogaster* (Burma, Sumatra, Borneo) is

actually holandric, and is to be looked on as the most primitive member of the family.

Drawina rawi may thus be regarded as the most primitive existing member of the genus, at any rate in respect of its male reproductive apparatus. There are other primitive features also:—(1) In a considerable number of species of the genus segment xi, which lodges the ovaries and female funnels, forms an "ovarian chamber," being shut out from the body-wall by the meeting and coalescence of the septa which bound it; in the present species however, as in some others, the septa have the usual arrangement, and there is no ovarian chamber. (2) In many species of the genus the setae are remarkably small, and in some may even be absent or unrecognizable in the most anterior segments, here however the setae are remarkably large for so small a worm. (3) The fact that the spermathecal atrium is large and sac-like may not improbably be another primitive feature; in this case the numerous species in which it is small, almost or entirely hidden in the body-wall, or even absent, would represent a secondary condition.

A specimen of *Branchiodrilus* (interesting, like *Branchiura*, from the possession of gills), the species unfortunately indeterminate, comes from Burhanpur in the Central Provinces. The genus, so far found only in India, and for long represented only by Bourne's *Chaetobranchus semperi* (Madras, 1890), has been in recent years rediscovered in Madras, and occurs also at Lahore and Lucknow.

The new species *Plutellus aquatilis*, *Eutyphoeus manipurensis*, and *Eudichogaster barkudensis* bring about no change in the areas of distribution of these genera as already known. *Megascolides annandalei* (Godaveri District, on the E. coast) extends the range of this genus to a region where it had not previously been found, the genus appears to be widely spread, but nowhere abundant.

The rediscovery of Bourne's *Perionyx saltans* after thirty-five years, in the Nilgiris, not far from where it was originally found, is interesting.

Systematic changes adopted in the present paper.

I have, following Michaelsen, restored the worm which for a long time has been known as *Lampito mauritii* to the genus *Megascolex*. Michaelsen, who in the Tierreich volume (6) had united Kinberg's genus *Lampito* with *Megascolex*, separated it again in 1909 (7), in consequence of finding two other worms which agreed with *L. mauritii* in the possession of a peculiar form of nephridial system,—micronephridia throughout the body, and meganephridia in addition in the postclitellar segments, to these three species Stephenson later added two others (13, 14). Michaelsen again fused the two genera in 1916 (8), since he had come to believe that the coexistence of micro- and meganephridia had no special impor-

tance; the peculiarity has arisen at various times, and is found in a number of genera of Megascolecinae,—*Megascolides*, *Notoscolex*, *Megascolex*, and *Phionogaster*. With this I agree, there are many varieties of nephridial distribution in the genus *Megascolex*, and I see no reason for separating the worms possessing this particular form of nephridial distribution as a separate genus, indeed. *M. escherichi* var. *papillifer* has this special arrangement while the type form of the species has not. Nor is there anything in the geographical distribution of the worms with this special arrangement to suggest a common origin.

The genus *Eudichogaster* I have placed under the subfamily Octochaetinae, instead of, as has been done by Michaelsen, under the Trigastrinae. I have discussed the question of the descent and systematic position of the genus at some length in a recent paper (16), and need not refer to it further here.

Michaelsen has recently (9) united the Glossoscolecidae and Lumbricidae as one family, the latter group becoming a subfamily, the Lumbricinae, and the several subfamilies of the former becoming subfamilies of the Lumbricidae, s.l. I can have no hesitation in adopting the view of one whose experience of these groups entitles him to speak with the authority of Dr. Michaelsen.

Fam. NAIDIDAE.

Gen. *Naïs*, O. F. M. *em.* Vejd.

Naïs paraguayensis, Mich.

Pachmarhi, Satpura Hills, Central Provinces; 300 ft. no date. F. H. Gravely. Numerous specimens.

Indian specimens have been found to be larger than those originally described by Michaelsen (5), and the number of their segments greater; this is the case also with the present specimens, the longest of which measured 13–14 mm. In one example 106 segments were counted, plus a posterior region of some little length in which new segments were about to be differentiated. None showed any sign of fission.

The coelomic corpuscles are large, a fairly large one being 16μ in diameter, and one of average size 12μ ; they are circular in shape, with a central nucleus.

No budding zone, nor any sign of approaching fission has apparently as yet been observed in this worm, nor have sexual organs been seen. It is therefore a question how the animal ordinarily reproduces itself. I think it possible that it does so by simple fragmentation,—i.e. without the formation of an internal budding zone,—and subsequent regeneration. Thus, in the present batch of material, besides the longer worms are some much shorter, with a large number of new segments, evidently rapidly produced, at the hinder end; this appearance of a considerable length of rapidly produced posterior segments seems to be a frequent characteristic (compare, for example, the description

and figure in 12). Others are shorter still,—about 30 segments,—with a short stumpy conical “tail,” evidently about to regenerate a hinder end. One or two fragments have not yet begun to regenerate, but these may possibly be simply the result of injury at the time of capture.

var. *barkudensis*, nov.

(Pl. XXVIII, fig. 1.)

Pond, Barkuda Island, Chilka Lake, Ganjam Dist., Madras Pres. Aug. 19 (no year). F. H. Gravely. Three specimens, all disintegrating.

The condition of the worms was quite useless for any study of the anatomy. The discrimination of the species of the Naididae however is based largely on setal characters; and since these were still discernible in the specimens,—and indeed more easily than in better preserved material,—it seems justifiable to offer the following description.

One specimen is a fragment 2 mm. long, incomplete at both ends; the other two are incomplete behind, and about 4 mm. long. The original length of the worm may thus be about 5 mm.

The anterior end, comprising the first six segments, is rather bulbous. There seem to have been no eyes; the pigment of the eyes is usually fairly resistant, and would have been visible if eyes had existed. As far as can be seen, there is no stomachal dilatation on the alimentary tube.

In one specimen there are 33 fully developed segments, followed by 21 very short and recently produced segments, after which the hinder end is broken off. In the other there are 31 segments, after which two short ones follow; these are apparently the beginning of a posterior series of rapidly produced segments, the rest of which are wanting.

The ventral setae of segments ii–v differ from those of the remainder of the body. In this anterior group of segments they are four per bundle, 100μ in length and 3μ in thickness; the nodulus is proximal to the middle of the shaft (proximal portion: distal portion: : 4 : 5); of the two terminal prongs, the distal is nearly twice as long as the proximal, and about equal to it in thickness at the base, or perhaps slightly thinner. In the rest of the body the ventral setae are 4–5 per bundle, their length 90μ and thickness 3μ ; the nodulus is distal to the middle of the shaft (proximal portion: distal portion: : 5 : 3 or almost 2 : 1); the prongs are equal in length, and the proximal is one and a half times as thick as the distal.

The dorsal setae begin in segment vi, and each bundle consists of two or three hairs and two or three needles,—perhaps most often of two of each. The hairs are about .25 mm. long, rather less than the diameter of the body. The needles, about 94μ in length, have a slight sabre-like curve; the nodulus is one-third the length of the shaft from the distal end, the tip is bifid, the prongs being visible to the ordinary high power, set at an acute

angle, that on the outer side of the curve of the shaft being rather longer and perhaps slightly stouter than the other (fig. 1).

Remarks.—In the absence of the posterior end of any of the specimens, there is no strict proof that they may not belong to the genus *Dero* or *Aulophorus*, which have gills around the anus, though their setal characters are similar to those of *Nais*. The existence of a long region of newly budded segments posteriorly, however, is very suggestive of *Nais paraguayensis*, and it is difficult to imagine developed gills at the hinder end of a series of rudimentary or still undifferentiated segments.

The three varieties of *Nais paraguayensis* form a series distinguished by the relative sizes of the inner and outer prongs of the dorsal needles:—

<i>N paraguayensis typica</i>	outer prong considerably smaller
„ „ var. <i>aequalis</i>	prongs equal.
„ „ var. <i>barkudensis</i>	inner prong smaller.

The difference between the typical form of the species and the present variety is such that, but for the existence of the intermediate variety *aequalis*, it would have been necessary to separate them as distinct species.

Gen. *Branchiodrilus*, Mich.

Branchiodrilus sp.

Burhanpur, Central Provinces. 4-6.iii.1919. F. H. Gravely. A small fragment, in a tube with *Aulodrilus remex*.

The fragment was incomplete at both ends, and the species therefore indeterminable.

Branchiodrilus menoni, Steph.

Madras, Prof. K. Ramunni Menon's collection 5.iii.1912. Seven specimens or fragments, in a tube with two specimens of *Branchiura sowerbyi*.

One specimen was undergoing fission, but showed no budding zone; the gills of the posterior animal began immediately behind the point of impending separation. The heads of the other specimens showed a prebranchial region of varying extent, sometimes small, sometimes comprising four seta-bearing segments.

Fam. TUBIFICIDAE.

Gen. *Branchiura*, Bedd.

Branchiura sowerbyi, Bedd.

Northern portion of Loktak Lake, Manipur, Assam; 2600 ft. 16-17.ii.1920. Three specimens.

Loktak Lake, Manipur; on *Vivipara lecythis*. 17.ii.1920. A single specimen.

Off Thanga Island, Manipur. 24.iii.1920. Three specimens, all fragments, two probably comprising together one individual.

Madras, Prof. K. Ramunni Menon's collection. 5.iii.1912. Two specimens.

The following measurements were made from two specimens of the first batch:—(a) Length of animal 62 mm.; whole gill-bearing region one-sixth of length of animal; length of gills half diameter of body; hints of gills on seven segments, gills quite small in the next seven, of moderate size on 51 segments, and small on the three last (total 68 segments with gills); (b) length of animal 60 mm.; whole gill-bearing region nearly one-third of the length of the animal; length of gills half diameter of body, hints of gills on 16 segments, gills quite small on the next 19, of moderate size on 64, and small on the terminal one or two (total 100).

Gen. **Tubifex**, Lm.

Tubifex (Tubifex) tubifex (O. F. M.).

Law's Falls below Coonoor, Nilgiris; ca. 6500 ft., 9'iv.1919. N. Annandale and R. B. S. Sewell. A number of specimens.

The only difference from the current diagnosis discoverable in the present specimens is in the ventral setae. The diagnosis gives the upper prong as longer than the lower. I find them usually equal, but slightly variable; either one or the other may be slightly the longer.

Gen. **Aulodrilus**, Bretscher.

Aulodrilus remex, sp. nov.

(Pl. XXVIII, figs. 2-6.)

Burhanpur, Central Provinces. 4-6'iii.1919. F. H. Gravely. Three specimens.

Some yellowish foreign matter had to be pencilled off two of the specimens, to which it adhered round a short length of the middle of the body in the manner of an incomplete tube.

Length 12 mm. Diameter .43 mm. anteriorly, the hinder portion of the worms was however much thinner, the diameter being .25 mm. one-third of the length of the animal from the hinder end. Segments 49 plus a considerable region of greater opacity where new segments are differentiating, and this again followed by a terminal transparent region, not divided into segments nor the site of formation of new segments (fig. 2). The number of new segments forming in the region of proliferation is very large, in one specimen about 30 can be distinguished, while in the type-specimen there are about 40, and even behind these there is a cellular mass where no differentiation of segments whatever can be made out, before we arrive at the transparent terminal region. The worm has thus a characteristic appearance.

There is no budding zone or sign of fission anywhere in the middle of the animal's length.

The prostomium has the shape of a blunt equilateral triangle. There are no eyes.

The dorsal setae begin in the second segment. The bundle consist of needles and hairs, the latter short, with a bayonet curve

(fig. 3); the hairs are only about half as long again as the needles, and thus are very much shorter than the diameter of the body. In the anterior segments some needles are singly pointed and rather blunt, and others, perhaps the majority, double-pointed with the outer prong much shorter and less conspicuous than the inner. In this anterior region the bundles consist of about seven needles with one, two, or up to four hairs.

Further back the needle setae of the dorsal bundles are peculiar and characteristic. The distal end becomes flattened and blade-like or oar-like, the tip being usually rounded in outline (fig. 4a), occasionally the flattened part retains a trace of the bifid character (fig. 4b). These oar-like setae begin in segment xiii in one specimen, in vii in another; they continue to the hinder end of the body. The number of setae in a bundle in the hinder part of the body is usually 5 needles with two or three hairs. The length of the needles in the anterior segments is from 74μ to a maximum of 98μ , and posteriorly about 60μ .

Some of the needles in the posterior dorsal bundles seem to be of the single-pointed type, but I think this is only the appearance of the flat blade seen edgewise. Indeed I am not absolutely confident that any are truly singly pointed even in the anterior dorsal bundles; in one specimen, mounted in glycerin and therefore showing details of setae more easily than the balsam preparations, I was unable to convince myself with the oil immersion lens that any of the dorsal setae which were in a favourable position for examination were certainly singly pointed.

The ventral setae are singly or doubly pointed needles, the bundles consisting of as many as nine in the anterior, and six or seven in the posterior region. In length they are about 86μ in the anterior, and 51μ in the posterior segments. Some setae in segments ii, iii and iv are singly pointed; with this exception all have a slight second outer prong (fig. 5); one, in an anterior segment, appeared to have two small outer prongs (fig. 6).

The pharynx extends back to the hinder end of segment iii; the oesophagus is narrow, and occupies segments iv to vii; then a sudden dilatation occurs, and thenceforward the tube is wide and occupies most of the available space in the segments. A pair of hearts are present in segment vi. The dorsal vessel is ventral in position, lying to the left side of the ventral vessel throughout most of the body, at the anterior limit of segment vii it mounts dorsalward, and becomes dorsal in vi. There are large parietal vessels, in complicated loops on the inner surface of the body-wall, in the posterior segments.

There was no trace of sexual organs.

Remarks.—The present form is at once distinguished from the two other species of the genus by the possession of the remarkable oar-like setae in the dorsal bundles.

Fam. MONILIGASTRIDAE.

Gen. *Drawida*, Mich.*Drawida raii*, sp. nov.

(Pl. XXVIII, fig. 7).

Forests of Shemoga and Kadur Districts, Mysore, S. India May, 1920.
A. Subba Rau. Several specimens.

External Characters.—Length 45 mm. Diameter 1.75 mm. Colour dark bluish grey to olive, somewhat lighter ventrally. Segments *ca.* 159. Anterior end of the body rather bulbous.

Prostomium prolobous.

No dorsal pores.

Setae closely paired, beginning in ii; remarkably large and prominent for so small a worm, especially in the ventral bundles of segments iii–xii. In the pregenital segments *aa* is rather greater than *bc*, or may be about equal to it; in the middle of the body *aa=bc*, *dd* is equal to half the circumference.

The clitellum was not present.

Over the ventral surface of segment xi, extending to its posterior limit, and encroaching anteriorly on the hinder end of x, is a thickened patch, with a definite and slightly swollen margin, rather rectangular in shape with rounded ends. It extends laterally on each side to not far from the line of seta *c*, and is thus broad from side to side and narrow antero-posteriorly. The male apertures are situated on small papillae in the antero-lateral corners of the patch, and are thus over the situation of furrow 10/11 and midway between *b* and *c*, rather nearer *b* (fig. 7).

Over furrow 9/10, and taking up the posterior third of segment ix and the anterior third of x, are a pair of transversely oval papillae, narrower at their internal ends and slightly sunk in their centres, while the periphery of each is swollen and definitely marked. Each extends from a point between *b* and *c* but rather nearer *b*, to not far from the middle line (fig. 7).

Neither the female nor the spermathecal apertures were visible externally, from internal dissection the latter open in the line of setae *ab* in groove 7/8.

Internal Anatomy.—Septum 5/6 is thin, 6/7, 7/8 and 8/9 are considerably thickened; 9/10 is somewhat strengthened; 10/11 11/12 and perhaps 12/13 slightly so.

There are two gizzards, in segments xiii and xiv.

Some of the nephridiopores are in *cd*, but I think not all.

The testis sacs are large, extending into both segments ix and x,—equally into both, or with the larger part in ix; they are not constricted by the septum. The vas deferens, narrow and coiled, lies on both sides of septum 9/10. The prostates are elongated, somewhat cylindrical or pear-shaped, rather narrowed towards their insertion in the body-wall. There is no distinct duct; the vas deferens, joining the gland below, can be seen running up its surface towards the free upper end. The surface of the glands is soft, and minutely papillated.

A second pair of prostates occurs in segment ix, of the same size, shape and appearance as the former in x. They are inserted into the body-wall near or in the situation of furrow 9/10, between the lines of setae *b* and *c*, though nearer, almost in *b*.

The ovaries are in segment xi, the septa here are quite normal, and there is no ovarian chamber, as occurs in so many species. The ovisacs extend back to segment xv; they are tubular as they pass through segments xii, xiii and xiv, and swollen in xv; or they may be moniliform, constricted by the septa.

The spermathecal ampullae are small and spherical, in segment viii; the duct is narrow and coiled, lying on the posterior face of septum 7/8. The atrium is a relatively large ovoid structure in vii, the duct entering near its base; it pierces the body-wall in the line *ab*.

Remarks.—The well-developed second pair of prostates, and the genital markings, are characteristic, and serve at once to distinguish the present species.

Fam. MEGASCOLECIDAE.

Subfam. MEGASCOLECINAE.

Gen. *Plutellus*, E. Perrier.

Plutellus aquatilis, sp. nov.

(Pl. XXVIII, fig. 8).

Small stream below Kotagiri, Nilgiris; ca. 5700 ft. N. Annandale and R. B. S. Sewell. A single specimen, broken into two.

External Characters.—Length of both pieces together 115 mm. Diameter 1.75 mm., near anterior end 2 mm.; a long thin worm. Unpigmented, colour grey, due to the intestinal contents; at anterior end quite pale. Segments 162; segment iv biannular, v–viii triannular, the rest simple.

Prostomium small, proepilobous.

Dorsal pores are present from furrow 8/9.

The setae are paired; in the middle of the body $ab = 2/5$ $aa = 1/2$ $bc = 2/3$ cd ; behind the genital region $ab = 1/3$ $aa = 2/5$ $bc = 1/2$ cd ; in front of the genital region $ab = 2/5$ $aa = 1/2$ $bc = 1/2$ cd (*i.e.* the lateral setae are not paired in front of the genital region); dd is less than half, and in the middle of the body is only one-third of the circumference, the setae *d* being above the lateral line of the body.

No clitellum was visible.

The male pores are on segment xviii, on small papillae which take up the interval between the lines of setae *a* and *b*; these papillae are connected across the middle line by a transverse ridge.

The female and spermathecal pores were not visible externally; from internal dissection the latter are found to open at the middle of the length of segments viii and ix, in the setal zone, and rather outside the line *b*.

There were no genital papillae or other markings.

Internal Anatomy.—Septum 5/6 is very thin; 6/7—13/14 are all present and all slightly thickened, the first few perhaps a little more than the rest.

The gizzard in segment v is large, firm, elongated, and barrell-shaped. There is a slight swelling of the oesophagus in segment xii, with close-set transverse vascular striations. The intestine begins in xv.

The last heart is in xii.

The excretory system consists of rather small meganephridia.

The testes and male funnels are free in segments x and xi. Seminal vesicles occupy segments xi and xii; they are small, those in xi smaller than the posterior pair, are much divided up into small lobules and thus have a racemose appearance; in both segments they are arranged in the form of a transverse band, continuous across the middle line, on the posterior surface of the septum (10/11 and 11/12).

The prostates are relatively large, the twisted tubular glandular portion occupies segments xviii–xxi or xviii–xxii. The duct is very thin, and much shorter than the gland; it is confined to segment xviii, and pursues a twisted course to pierce the body-wall in line with setae *b*. There are no penial setae.

The female organs have the usual situation.

The spermathecae are two pairs, in segments viii and ix (fig. 8). The ampulla is of an oval or inverted pear-shape. The duct is about as long as the ampulla, moderately stout, of an equal diameter throughout, and either straight or rather twisted in its course. The single diverticulum is tubular, as long as the main pouch (ampulla plus duct), and arises from the ectal end of the duct; in one of the four spermathecae its ental half is rather twisted, and showed three small rounded seminal chambers as irregularly arranged swellings; this is the organ illustrated in the figure, which I take to be the fully developed form. Of the other three spermathecae, one appeared to have no diverticulum, and in the remaining two the diverticulum was simply tubular and transparent.

Remarks.—This species bears a considerable resemblance to *P. indicus*, Mich.; the latter differs however in having the setae *cd* paired in the preclitellar region, the posterior spermathecal apertures in groove 8/9, the seminal vesicles in ix and xii, a straight prostatic duct, and a shorter spermathecal diverticulum with a single seminal chamber.

Gen. **Megascolides**, McCoy.

Megascolides annandalei, sp. nov.

(Pl. XXVIII, fig. 9).

Dowlaishweram, Godaveri Dist. 29.viii.1918. N. Annandale. Five specimens, all sexual.

External Characters —Length 95 mm. Diameter 5 mm. Colour pale, unpigmented, no difference between dorsal and ventral surfaces. Segments 130; segment v is triannular, vi triannular and partially (ventrally) 4-annulate; segments vii and onwards to the clitellum are triannular, or triannular with one or two secondary rings; while behind the clitellum the segments show three annuli with some secondary annuli in addition.

The prostomium, withdrawn under segment i, appears to be prolobous. There is a short median groove dorsally on segment i, which extends backwards from the prostomium over two-thirds of its length or more, or even to the hinder end of the segment.

Dorsal pores begin in groove 12/13.

The setae are paired; in the middle of the body $ab = 1/3$ to $2/7$ $aa = 1/2$ bc or slightly less $= cd$, behind the clitellum $ab = 2/7$ $aa = 2/5$ $bc = cd$; in front of the clitellum $ab = 1/4$ $aa = 1/3$ bc and is slightly less than cd , in the anterior segments $ab = 2/5$ $aa = 1/2$ $bc = cd$. The median dorsal distance $dd = 2/3$ of the circumference.

The clitellum is swollen, smooth, without annulation, and comprises segments xiii–xvii (= 5).

The male genital field is a transverse depression on segment xviii which extends from a point outside the line b on one side to a corresponding point on the other, and includes the whole length of the segment. The male pores appear as pits in line with setae b , in front and behind the pores are curved grooves, with the concavities facing each other, so that the region of the pore has an eye-like appearance.

The female area is a transverse oval depression on segment xiv just in front of the setal zone, the actual apertures were not distinguishable.

The spermathecal apertures are one pair, in groove 7/8, in line with b , or between a and b .

Internal Anatomy.—Septum 4/5 is slightly thickened, 5/6—8/9 considerably, 9/10 and 10/11 moderately and 11/12 and 12/13 slightly so.

The gizzard, in segment v, is of moderate size, firm and rounded. There are calciferous glands in xi and xii, stalked, and lamellated internally. The intestine begins in xv.

The last heart is in xii. In segment xiii is a large vessel, not bulged after the manner of a heart, which runs on each side from the middle line in front in a backward, outward and downward direction.

The excretory system is micronephridial. Behind the clitellum the micronephridia are arranged on each side in a transverse row of about six, the inner two or three on each side being smaller than the rest; in the clitellar region they are considerably more numerous, about ten on each side in each segment, and in less regular rows than behind the clitellum. Towards the hinder end of the body there are about seven or eight on each side, and of these the inner three or four are smaller than the rest, except the

innermost of all; this increases in size, and forms a more compact coil than the dorsally situated nephridia of the row, though it is not so elongated in a transverse direction as these.

The testes and male funnels are free in segments x and xi. Seminal vesicles occupy segments ix and xii, those in the latter segment being large, contiguous in the middle line dorsally, and slightly bulging back septum 12/13, the pair in ix are slightly, those in xii considerably lobed.

The prostates are tubular, of moderate size, closely coiled, and cause the septa bounding segment xviii to bulge apart somewhat. The duct is much narrower than the glandular part, is bent on itself, short, slightly shining, the ectal part wider than the rest.

Ovaries and female funnels are present in segment xiii.

The spermathecae (fig. 9) are one pair only, in segment viii. The ampulla is moderately large, of an inverted pear-shape, and marked by a number of slight annulations. The duct is short, one-third to a quarter of the length of the ampulla, bulged in its upper portion, narrowed at its ectal end, with a row of four or five small seminal chambers on its inner side which take up the greater part of its length.

The penial setae are apparently two in each bundle. In length they are .66 mm.; in form tapering, slightly bowed, the curve more marked towards the distal end, the tip slightly hooked and rounded; there is no ornamentation except a few very fine transverse markings or slight notches on the distal portion a little distance from the tip,—so slight that they might be accidental.

Remarks.—The nearest ally of the present form appears to be *M. duodecimalis*, from Parambikulam, but the presence of only one pair of spermathecae distinguishes the present species. The penial setae, and the curious row of seminal chambers sessile on the spermathecal duct, are also characteristic.

Gen. *Megascolex*, Templeton.

Megascolex mauritii (Kinb.).

Dowlaishweram, Godaveri Dist. 29.viii.1918. N. Annandale. Two specimens.

Amini, Laccadive Islands. 21.x.1920. Madras Fisheries Dept. Three specimens.

Kalpeni. Laccadive Islands, 18.xii.1920. Madras Fisheries Dept. Four specimens.

Agatti, Laccadive Islands. 3.xii.1920. Madras Fisheries Dept. Five specimens.

Kavarti, Laccadive Islands. 11.xii.1920. Madras Fisheries Dept. Three specimens.

Androth, Laccadive Islands. 23.xii.1920. Madras Fisheries Dept. Four specimens.

In addition, three specimens of which the label was lost, probably from Androth.

Megascolex konkanensis, Fedarb.

Agatti, Laccadive Islands. 3.xii.1920. Madras Fisheries Dept. A single specimen.

A single specimen, probably from Androth, Laccadive Islands (label lost.)

Gen. *Pheretima*, Kinb. em. Mich.*Pheretima hawayana* (Rosa).

The Residency, Imphal, Manipur. 2·iii·1920. Four specimens.
Same place. No date. Two specimens.

Pheretima heterochaeta (Mich.).

The Residency, Imphal, Manipur. 2·iii·1920. Three specimens.
Small stream running from swamp below Kotagiri, Nilgiris; *ca.* 5700 ft.
3·iv·1919. N. Annandale and R. B. S. Sewell. A single specimen.

Gen. *Perionyx*, E. Perrier.*Perionyx* sp.

Khandala, Bombay, under stones and masses of weed at bottom of wet rocks near waterfall. July, 1919. R. B. S. Sewell. Several specimens, immature.

Perionyx excavatus, E. Perrier.

Ilangol Hills near Lamphal Pat (Lake), close to Bishenpur, Manipur, Assam; 2600 ft. 1·iii·1920. Two specimens.
The Residency, Imphal, Manipur. 2·iii·1920. Numerous specimens.
Same place. No date. Numerous specimens.
Paddy fields, Potsengbham, N. of Loktak, Manipur. No date. Manipur Survey Party. Numerous specimens.
Swamps round about Thanga Island in Loktak Lake, Manipur. 21·ii·1920. Very numerous specimens.

Perionyx saltans, A. G. Bourne.

Small rocky stream below Kotagiri, Nilgiris; *ca.* 5700 ft. 4·iv·1919. N. Annandale and R. B. S. Sewell. Two specimens, immature.

In 1886 Bourne (2) gave a description of a small *Perionyx* from Ootacamund and Naduvatam in the Nilgiris, in which, as in *P. sansibaricus* subsequently described by Michaelsen (4), the nephridiopores alternated in position in successive segments. Though the resemblance between the two is considerable, Michaelsen refrained from uniting his specimens with Bourne's species, since *P. saltans* has two spermathecal diverticula while *P. sansibaricus* has only one.

Though the present specimens are immature, in one there are signs of the male pores. This was accordingly opened, and three of the spermathecae, still very small, examined microscopically; of these two showed two diverticula each, the third a single one, which was however bilobed. It appears therefore that the specimens belong to *P. saltans*; the species had not previously been found since Bourne's original discovery.

The specimens being immature scarcely allow of an extension of Bourne's description. The more advanced of the two was 31 mm. long, and comprised 66 segments, but the hinder end was regenerating; it was 2 mm. in diameter. The other had a length

of 40 mm., a diameter of 1.75 mm., and 108 segments. Bourne's data are rather unusual,—length 60 mm., segments 61, it is uncommon, in a small worm such as this, to find the segments on an average 1 mm. long; his specimens must have been unusually relaxed. The prostomium is epilobous 2/3. The dorsal pores begin in one specimen in groove 3/4, in the other in 4/5.

The numbers of the setae correspond to Bourne's figures. I found 50 in an anterior segment, and 46 and 47 in the middle of the body; the ring is closed ventrally, and almost so dorsally (zz=2yz).

It is not always the case, as Bourne says, that a segment which has the outer (dorsal) position of the nephridiopore on one side has the inner (ventral) on the other; the alternation of the position in successive segments is not strict, and hence the above statement of Bourne's sometimes holds and sometimes does not; the rule however is as given by Bourne. The nephridia end in considerable end-sacs, as in *P. sansibaricus*.

The male pores, as noted by Bourne, are situated in a median depression; this has sloping sides, and takes up the whole length of segment xviii.

Perionyx sansibaricus, Mich.

Small jungle streamlet, Bandy Shola, near Coonoor, Nilgiris; ca. 5500 ft. 8.iv.1919: N. Annandale and R. B. S. Sewell. Eight specimens.

Small jungle stream, Longwood Shola, near Kotagiri, Nilgiris. 4.iv.1919. N. Annandale and R. B. S. Sewell. Three specimens.

I append a few notes which serve to amplify previous descriptions.

The dorsal pores in a number of specimens examined begin as far forwards as groove 2/3; in one the pores appeared rudimentary in 2/3 and 3/4, and were well marked behind this.

The small male field varies in appearance; it is always depressed, but the depression may be rectangular, oval, or nearly circular, the bottom flat or marked by a transverse groove at the ends of which the pores probably lie; the sides may be steep or gradually sloping. I did not in these specimens observe, as I did in a previous batch (15), that the setal ring was continued across the ventral surface immediately behind the male pores.

The clitellum, not well marked, extended over segments xiv—xvi (=3).

No septa are noticeably thickened. The gizzard, in vi, is extremely rudimentary. I found no calciferous gland-like swelling of the oesophagus in segment xii. The last heart is in segment xii. The position of the alternating nephridiopores is about 2/5 of the half-circumference from the midventral and 1/5 of the half-circumference from the mid-dorsal line.

The spermathecal diverticulum consists of three or four closely aggregated seminal chambers.

There are no penial setae.

Perionyx mysorensis, sp. nov.

(Pl. XXVIII, fig. 10).

Forests of Shemoga and Kadur Dists., Mysore, S. India. May, 1920.
A. Subba Rau. A single specimen, incomplete behind, not fully mature, in poor condition.

I at first decided against describing the present species; but the various parts of the sexual apparatus are present (except the clitellum) though small, and the penial setae, in conjunction with the other characters, will allow of the species being recognized when it is met with again.

External Characters.—Length 38 mm. (incomplete posteriorly). Diameter 2 mm. Segments present 90. Colour light brownish purple dorsally, pale ventrally.

Prostomium rather broad, prolobous or slightly epilobous.

Dorsal pores present.

Setae in rings, closed dorsally and ventrally. In segment xix they were about 54 in number, in the middle of the body about 62.

The clitellum was not distinguishable.

The male pores, in segment xviii, are situated close to the middle line, each in a small depression, the depressions themselves lying on a transverse ridge across the middle of the segment. This ridge is not elevated above the general surface, and comes into existence through the presence of two depressions, which have the form of short transverse trenches and occupy the anterior and posterior fourths of segment xviii, in front of and behind the pores; the trenches are continuous with the intersegmental fissures (17/18 and 18/19), and in transverse extent are about equal to the antero-posterior length of the segment.

The female apertures were not seen.

The spermathecal pores are small, in grooves 7/8 and 8/9, near the middle line.

Internal Anatomy.—Septa 6/7–9/10 are somewhat thickened, and also 12/13–15/16.

The gizzard,—hardly to be called a gizzard,—is quite vestigial, in segment vi. There are lateral swellings of the oesophagus in xiii, and to some degree in xiv, but they cannot be called calciferous glands.

The last heart is in segment xii.

Testes and funnels are free in segments x and xi. Seminal vesicles occupy segments xi and xii, they are moderately large, but do not meet dorsally in the middle line.

The prostates are small, and confined to segment xviii; each is a squarish mass, cut into deep lobes. The duct is short, straight, moderately stout relatively to the size of the gland, of the same diameter throughout, and passes transversely inwards.

Ovaries and funnels are present in segment xiii.

The spermathecae are two pairs, small and perhaps not fully developed; they are spherical, sessile on the body-wall, to which

they are attached by a rather broad base ; there is no hint of a diverticulum.

The penial setae (fig. 10) are .44 mm. long and 8μ thick at the middle, slightly bowed, the curvature being more marked at the proximal end ; the tip is tapering and fairly sharply pointed. The ornamentation consists of a few transverse markings irregularly distributed and each composed of a row of extremely fine teeth.

Subfam. *OCTOCHAETINAE*.

Genus *Octochaetus*, Bedd.

Octochaetus barkudensis, Steph.

Barkuda Island Chilka Lake, Ganjam Dist Madras Pres. Aug., 1919. F. H. Gravely. A single specimen.

On old brick-field in the same locality. 10'x'1920. N. Annandale. Three specimens.

The variations in the arrangement of the micronephridia in this and allied genera are of some interest. In the present species the nephridia in the anterior part of the body are small and scattered, not arranged in a single row per segment. Towards the hinder end they are arranged in two fairly definite rows in each segment, one behind the anterior and one in front of the posterior septum ; there is no constant difference in size between the nephridia of different parts of the row.

The gizzard in these specimens is an obliquely placed muscular ring, which leaves the posterior part of the ovoid oesophageal swelling quite soft above, and similarly the anterior part of the dilatation is quite soft below.

Gen. *Eutyphoeus*, Mich.

Eutyphoeus manipurensis, sp. nov.

(Pl. XXVIII, fig. 11).

Swamps round about Thanga Island in Loktak Lake, Manipur. 21' ii' 1920. Three specimens.

External Characters.—Length 120 mm. Diameter 5 mm. Segments 162 ; segment iv is biannular dorsally, v and vi biannular, vii triannular but with four annuli dorsally : subsequent segments as far as the clitellum are multiannular, the number of annuli varying, but as a rule three chief annuli can be distinguished ; behind the clitellum the segments are triannular. Colour dark grey throughout, rather lighter ventrally.

Prostomium tanylobous, with a slightly marked transverse furrow behind the prostomial lobe, and another similar one half way along segment i. Segment i. is fissured radially round its anterior border.

The dorsal pores begin in groove 10/11.

The setae are paired. In the middle of the body $ab=2/5 aa$ $=1/2 bc=2/3 cd$ (or sometimes $=1/2 cd$, i.e. the lateral setae are

then not paired); behind the clitellum $ab=2/5$ $aa=2/5$ $bc=4/7$ cd ; in front of the clitellum $ab=1/2$ $aa=1/2$ $bc=3/5$ cd ; $dd=4/7$ of the circumference.

The clitellum includes $2/3$ of $xiii-2/3$ $xvii$ ($=4\ 1/3$).

The male pores are on $xvii$, on prominent round papillae which take up the interval between the lines a and b ; round each papilla is a deep trench, the outer margin of which is slightly swollen and indented. The ventral surface of segment xvi is much depressed and fissured; genital markings were present as follows:—In one specimen there were none, beyond the irregular fissuring. In a second there were a pair of eye-like markings, each an oval rather depressed area with raised margin, behind the setal zone and corresponding to the interval ab , and in addition a similar but circular marking midventrally and in front of the setal zone. In the third specimen the paired markings were present as above; and in addition a transverse row of four circular markings, touching each other, across the ventral surface in the setal zone.

The female pores were not made out.

The spermathecal pores are one pair, in groove $7/8$, slit-like, with their centre in ab , rather nearer to a than to b . The middle annulus of segment $viii$ may be raised and "glandular," and small papillae occur variously in this region; in one specimen there was a small papilla just behind the spermathecal aperture of the right side, and another in the midventral line on the glandular swelling of segment $viii$; in another specimen there was a small papilla midventrally on segment ix ; in the third there were no papillae.

Internal Anatomy.—Septum $4/5$ is slightly, $5/6$ much thickened; the next septum is $8/9$, which is somewhat strengthened; $9/10$ is considerably thickened, and $10/11$ very stout, septum $11/12$ is present, though thin (unlike most species of the genus, in which it is absent), and the rest are thin. Septum $8/9$ is attached to the parietes a little in front of groove $9/10$, septa $9/10$ and $10/11$ are confluent at their insertion into the body-wall, which is situated in the middle of segment x as determined externally,—*i.e.* midway between furrows $9/10$ and $10/11$; septum $11/12$ is normally situated.

The gizzard occupies the middle of the interval between septa $5/6$ and $8/9$; it is large, round and firm, and the oesophagus in front of the gizzard, between the gizzard and septum $5/6$, is also strengthened. There are large dark lateral swellings of the alimentary tube in segment xii , but they are not set off from the side of the canal. The intestine begins in xv .

The last heart is in segment $xiii$; that of segment xi is normally situated with reference to septum $11/12$,—on its anterior face. There are two transverse vessels in front of septum $8/9$ and behind the gizzard (belonging to segments $viii$ and vii), one at the anterior border of the gizzard (segment vi), one in front of septum $5/6$ (segment v), but none in front of septum $4/5$. The dorsal vessel is continued forwards on to the pharynx much diminished in size

The micronephridia are somewhat sparsely scattered. Behind the clitellum they form a single transverse row in each segment, which consists on each side of a number set pretty close together ventrally, with four more dorsally placed at considerable intervals.

Testes were not identified; there are two pairs of funnels apparently free, in segments x and xi. Seminal vesicles of moderate size, lobed, are present in segment ix, and also in xii or xii—xiii, much lobed and larger than the anterior pair.

The tubular prostates form a close coil occupying segments xvii—xix or xx. The duct is also much coiled, of moderate length, narrower than the glandular part, of the same diameter throughout, and only slightly shining.

The female organs have the usual situation.

The spermathecae are one pair, in the anterior part of the interval between septa 5/6 and 8/9. Each is an ovoid sac, sessile on the parietes by a considerable portion of its under surface. There is a single diverticulum on the outer, or posterior and outer, side, of some size, also practically without stalk, slightly lobulated, one-third as broad and half as high as the ampulla.

The penial setae (fig. 11) are 1.5 mm. long and 47μ thick at the middle, with straight shaft and slightly curved tip tapering to a blunt point. The ornamentation consists of a number of fine triangular teeth on the curved tip.

Remarks.—The present species comes near *E. mohammedi*, from which however it is distinguished by the genital marking and the character of the spermathecal diverticulum.

Gen. *Eudichogaster* Mich.

Eudichogaster barkudensis, sp. nov.

(Pl. XXVIII, figs. 12, 13).

Barkuda Island, Chilka Lake, Ganjam Dist., Madras Pres. Aug. 1919. F. H. Gravely. Several specimens.

External Character.—Length 57 mm. Diameter max. 1.75 mm. Segments 130; first segment very short. Colour pale, unpigmented, appearing grey from intestinal contents showing through.

Prostomium proepilobous.

Dorsal pores begin from furrow 11/12.

The setae are paired. The ratios are nearly the same throughout the body; in the middle of the body $ab=1/2aa$ or nearly so $=2/3bc=3/4cd$; further back bc and cd may be almost equal; behind the clitellum $ab=2/5aa=1/2-4/7bc$; dd =half the circumference in the middle of the body and behind, and $4/7$ the circumference in the anterior part of the body.

The clitellum extends over xiii– $\frac{1}{2}$ xvii ($=4\frac{1}{2}$); it is yellowish brown in colour, and constricted.

The prostatic pores are one pair, on segment xvii, situated on round papillae which take up the interval between the lines *a* and *b*; they are slit-like, and obliquely placed, diverging from each other backwards.

The female apertures are minute pores in a circular white patch on the anterior part of segment xiv.

The spermathecal apertures are represented by a pair of very minute white points on segment viii, just in front of setae *a*.

Internal Anatomy.—Septum 4/5 is thin, 5/6 extremely tenuous. 6/7 and 7/8 also very thin; 8/9 is thin, 9/10 and 10/11 slightly strengthened; 11/12, 12/13 and 13/14 are thin, but slightly strengthened by comparison with those that follow (the specimen was in a poor state of preservation, and possibly the septa are normally somewhat thicker than the above description would lead one to suppose).

There are two gizzards, in v and vi, of comparatively large size, firm and rounded. Calciferous glands are present in segments x, xi and xii, not stalked, and diminishing in size backwards. The intestine begins in segment xv.

The last heart is in segment xii.

The excretory system is micronephridial. The organs are of relatively moderate size, in front of and in the clitellar region they are scattered; behind the clitellar region they form a transverse row of four (three to five) on each side in each segment, those towards the ventral end of the row being smaller and closer set. About 27 segments from the hinder end the innermost nephridium of each row enlarges and the arrangement comes to be as follows:—one nephridium, a long thin loop, between seta *d* and the middorsal line; one small, lying in line *c*; and one, the largest and thickest extending from *a* outwards to between *b* and *c*; the series thus consists of three on each side.

There is a pair of large and conspicuous male funnels in segment x, and a smaller pair in xi. On the other hand testes were identified in xi, but not in x. No seminal vesicles were present.

The prostates are one pair, in xvii, small, tubular, and placed transversely in the segment. The duct, also transversely placed, is thin, and in length equal to the glandular portion.

The female organs have the usual situation.

The spermathecae (fig. 12) are one pair, situated in segment vii; they open externally as described above, on segment viii, septum 7/8 being rather obliquely placed. Each is a narrow elongated somewhat cylindrical tube, .66 mm. long, slightly curved, and rather wider in its ectal portion; a short terminal section which narrows to its insertion into the body-wall, may be described as the duct. A small sac-like diverticulum is given off from the junction of ampulla and duct.

The penial setae (fig. 13) are .53 mm. long, and very slender, 2.5μ in thickness, they are bowed towards the distal end, where the shaft is twisted and somewhat sinuous in outline; the tip however is straight, and ends in a small rounded flat expansion which al-

most appears bifid, owing to the thinness of the expansion between its thicker margins.

No copulatory setae were discovered in the spermathecal region.

Fam. LUMBRICIDAE.

Subfam. MICROCHAETINAE.

Gen. *Glyphidrilus*, Horst.

Glyphidrilus annandalei, Mich.

Forest of Shemoga and Kadur Dists., Mysore, S. India. May, 1920.
A. Subba Rau. A number of specimens.

Most of the present specimens appear to have undergone autotomy a little distance behind the genital region, or in some cases further back, near the hinder end. Two specimens in which the characteristic ridges and papillae were only just beginning to appear had not broken; possibly the worms are more liable to fragmentation at the time of sexual maturity.

The clitellum begins in these specimens in xvii or even xvi, and ends indistinctly about xxxv or xxxvi. The "wings" begin in xxv (*i.e.* rather in front of the usual place); but they are not in any of the specimens continued further forwards as lower ridges.

The midventral series of papillae are almost constant in position, on segments xiii-xxi (once xii-xxi); they regularly diminish in size posteriorly. The anterior lateral series also begin constantly on xiii, and show in every case a peculiar arrangement, not noted in any previous account of the species; the first papillae of the series are situated between the lines *b* and *c*, succeeding ones rapidly become more dorsal, so that the fourth and fifth, on segments xvi and xvii, are between *c* and *d*; the series then returns even more rapidly to its original alignment, so that the seventh papilla, on segment xix, is again between *b* and *c*. This anterior lateral series ends on segment xxiv; there is another short series, as usual, behind the "wings."

In contrast to previous data for the species, the whole papillar arrangement is very constant, and peculiar in the respect noted above; but it does not seem worth while establishing a variety for the present specimens.

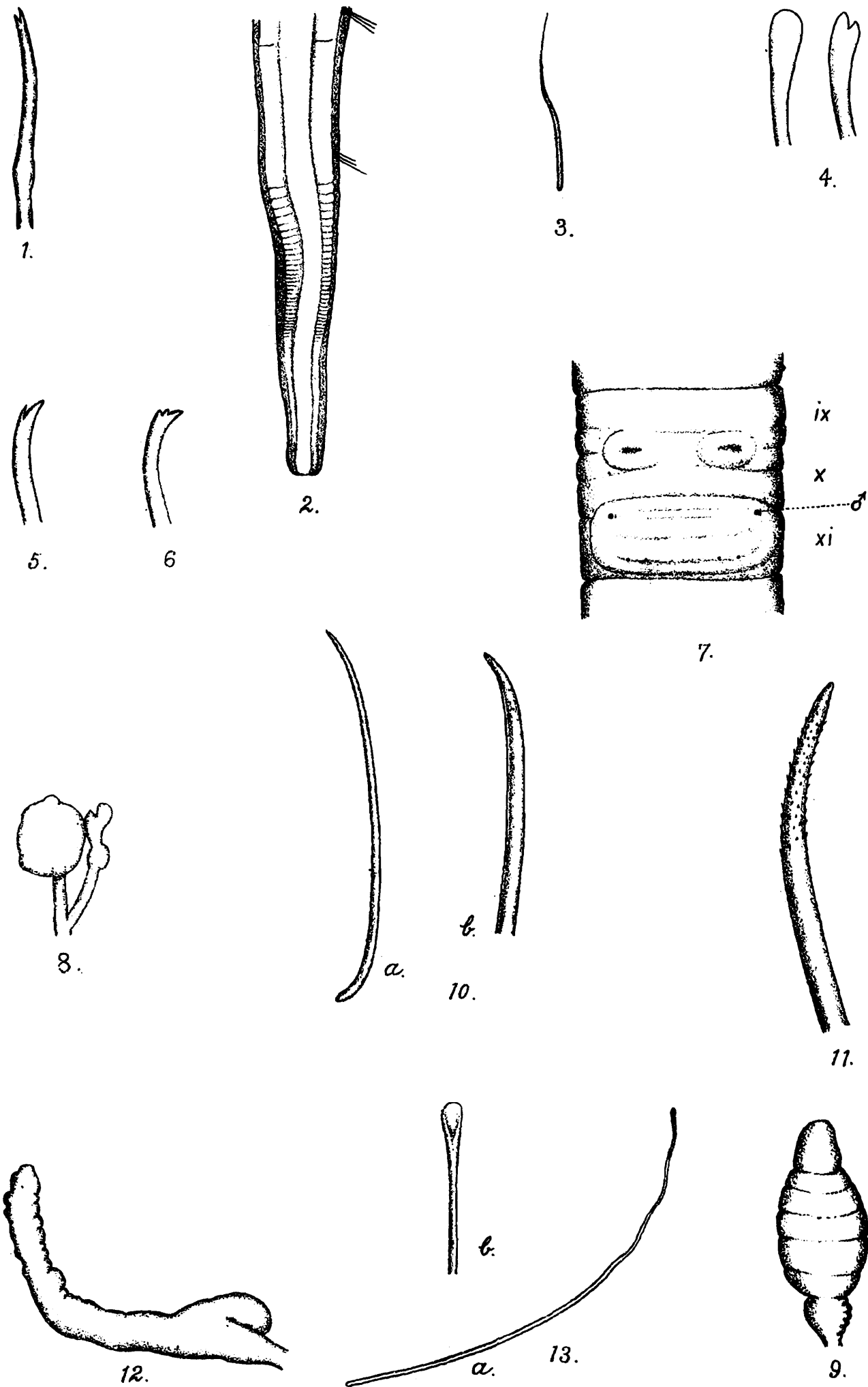
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EXPLANATION OF PLATE XXVIII.

- FIG. 1.—*Nais paraguayensis* var. *barkudensis*; distal end of dorsal needle seta, $\times 800$.
- „ 2.—*Aulodrilus remex*; hinder end, showing zone of proliferation some distance in front of anus, $\times ca. 70$.
- „ 3.—The same, dorsal hair seta, $\times 230$.
- „ 4.—The same, *a*, usual form, and *b*, exceptional form of distal end of oar-shaped setae of dorsal bundles; $\times ca. 1150$.
- „ 5.—The same, tip of ventral seta, $\times ca. 1200$.
- „ 6.—The same, tip of an exceptional form of ventral seta, $\times ca. 1200$.
- „ 7.—*Drawida rawi*; genital field; $\times 18$. ♂, male pore.
- „ 8.—*Plutellus aquatilis*; spermatheca.
- „ 9.—*Megascolides annandalei*; spermatheca.
- „ 10.—*Perionyx mysorensis*, penial seta, *a*, general form, $\times 130$; *b*, distal end, more highly magnified, $\times ca. 400$.
- „ 11.—*Eutyphoeus manipurensis*, distal end of penial seta; $\times ca. 150$.
- „ 12.—*Eudichogaster barkudensis*, spermatheca.
- „ 13.—The same, penial seta, *a*, general form, $\times 125$, *b*, distal end more highly magnified, $\times 500$.



J. Stephenson del.

A. Chowdhary lith.

NEW INDIAN OLIGOCHAETES.