NOTES ON FISHES IN THE INDIAN MUSEUM.

XVII.—Loaches of the genus *Nemachilus* from Burma.[1]

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(Plates XIV, XV.)

The fishes of the genus *Nemachilus* are widely distributed in the hill streams of India and Burma and only a few of them are adapted to life in slow-running or stationary waters at high altitudes. Usually they are of a small size and are characterized by the possession of an almost cylindrical or a somewhat depressed body. They live among pebbles and shingles at the bottom of a stream and are very active in their habits. At the slightest provocation they dart from one place to another and always rest with their heads pointing upstream,[2] and are thus able to offer a minimum resistance to the force of the rushing current. The colouration of these loaches is very characteristic so far as the Indian species are concerned. With the exception of a few species they are marked with a variable number of vertical bars. These stripes have a great biological significance as they make the fishes living among pebbles in shallow, clear, rapid-running water inconspicuous. It has very often happened that the net revealed the presence of these fishes where I could not see them in the clear water even when a few inches deep.

Nemachili are Cobitidae without a pre- or sub-orbital spine and with a relatively short dorsal fin in which the number of branched rays does not exceed 20. Among the Indian freshwater fishes there are few genera whose taxonomy is involved in such great confusion as that of *Nemachilus*. This is in part due to the fact that many of the species exhibit considerable individual variability. Moreover, most of the

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[1] For a number of years I have been collecting material for a revision of the fishes of the genus *Nemachilus* found in India. My colleagues in the Zoological Survey of India and I have made extensive collections of these loaches and a considerable amount of material has been got together from almost all parts of India. During my recent visit to Europe I compared this material with the types and the old specimens in the collection of the British Museum. Specimens of the Indian species were also examined in the Museum National d'Histoire Naturelle, Paris; in the Zoologisches Museum der Universität, Berlin and in the Museo Civico di Storia Naturale, Genova. The collection at my disposal is so large and the taxonomy of these loaches is so confusing that I have thought it best to treat them in small batches according to their distribution. The present paper is the first of the series that I propose to publish in this journal from time to time.

[2] Fishes of the genus *Nemachilus*, on account of their active habits, are very difficult to catch. The best way to collect them in large numbers was to divert the course of a small channel by a dam. In the portion of the bed thus made dry these fishes can be obtained by turning over stones. Where this was not possible a bag-net was dragged at a great speed among the pebbles in the shallow portion of a stream. In this way all those forms that rest underneath stones could be netted. The presence of pebbles in the net provides the fish with hiding places and at the same time obstructs them from getting away. I have often collected large numbers of specimens in this way.

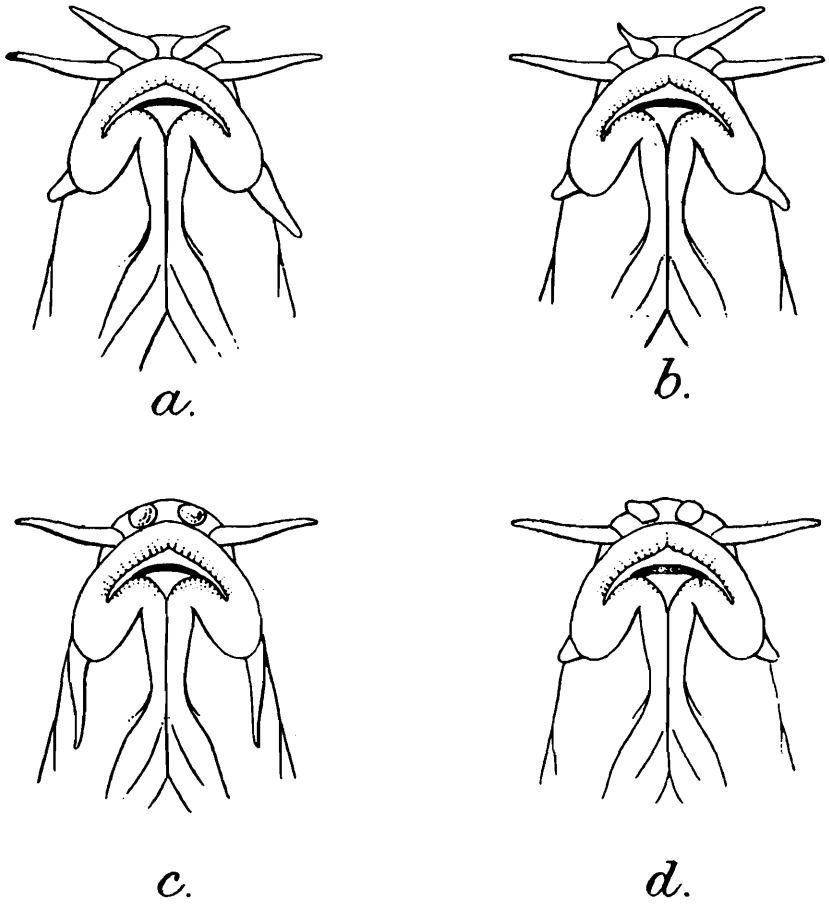
specific standards, such as number of fin-rays, scale counts, body proportions, colouration, etc., which are used in distinguishing species of most of the other Cyprinoid genera, are of very little significance in the case of *Nemachilus*. Fortunately most of the Burmese species are very peculiar and, therefore, little difficulty has been experienced in characterizing them. In distinguishing closely allied species I have relied on the character of the lateral line, the position of the anal opening with regard to the ventrals and the position of the commencement of the dorsal with regard to its distance from the tip of the snout and the base of the caudal. It is a well known fact in biology that similar environmental conditions tend to produce similar characters, and it is probable that the great resemblance between the various species of *Nemachilus* is due to a similarity in their environment, for wherever any species has taken to a life in slow running waters, it has become peculiarly modified. The usual environment—rapid-running water—of these loaches is full of storm and stress and the animals that inhabit it have to adjust themselves constantly to any fluctuations in the external conditions of their existence. In these circumstances the organisms are being modelled and remodelled till ultimately the elucidation of their true systematic position becomes a matter of considerable difficulty. This is not only true of the fishes of the genus *Nemachilus* but is also the case with all other hill-stream genera of fishes that I have studied so far.

Attempts have been made to subdivide the vast assemblage of species grouped under the generic name *Nemachilus*, but, so far as I am aware, none has proved satisfactory. In 1903, Jordan and Fowler [1] established the genus *Elixis* to accommodate those species of *Nemachilus* which possess a nasal barbel. This genus has been accepted by Weber and Beaufort [2] but, in 1920, Annandale and I [3] doubted the generic value of this character though at that time we did not assign any reasons for our views. A perusal of the descriptions of the Burmese species is enough to show that the nasal barbel is very variable and that no specific value can be attached to it, except in such species as *N. evezardi*, where it is extremely well developed. In the material that I have examined there are a number of species showing all possible gradations between the total absence and the presence of a distinct nasal barbel. Among the Burmese species *N. cincticauda* possesses a short but well-marked nasal barbel; in *N. acuticephalus* the membrane between the nostrils is well developed and is produced into a short process in the middle; in *N. raoe* the anterior nostril is somewhat tubular and the tube is produced into a flap-like projection and in *N. brevis* the anterior nostril is produced into a long, tube-like structure.

Attention may here be directed to a species—*N. guttatus*—described by McClelland [4] from Jorhat in Assam and characterized by the possession of only four barbels. I have not examined any specimen of this

[1] Jordan & Fowler, *Proc. U. S. Nat. Mus.* XXVI, p. 768 (1903).
[2] Weber & Beaufort, *Fish. Indo-Austral. Archipel.* III, p. 35 (1916).
[3] Annandale & Hora, *Rec. Ind. Mus.* XVIII, p. 185 (foot-note), (1920).
[4] McClelland, Ind. Cyprinidae in *As. Res.* XIX, pp. 305, 438, pl. lii, figs. 5 & 6 (1839).

species, but it seems likely that McClelland was dealing with an abnormal specimen in which one of the pairs of barbels was greatly reduced



TEXT-FIG. 1.—Ventral surface of head of 4 specimens (*a-d*) of *Nemachilus kessleri* Günther showing defective barbels.

or totally lost. In a large series of examples of *N. kessleri* I have found a number of specimens in which the barbels are defective and one specimen, in which both the anterior rostrals are rudimentary (text-fig. 1, *c.*), appears to possess only 4 barbels. I have briefly referred to this example here to show that little importance should be attached to the number of barbels in separating the different species of *Nemachilus.*

Nichols,[1] as a result of his examination of the Chinese collection in the American Museum of Natural History, has recently proposed four groups in the genus *Nemachilus.* In the absence of any Chinese material for examination in Calcutta I do not feel myself justified in offering any remarks on Nichols' classification. It may, however, be remarked that the characters he has employed in distinguishing his groups show considerable variation in the material before me and consequently I have not been able to adopt his classification. When the systematic treatment of Indian species is completed it may be possible to review the generic classification of *Nemachilus* and related loaches.

[1] Nichols, *American Mus. Novitates*, No. 171, pp. 1-7 (1925).

Many lacunae remain to be filled up in our knowledge of the fresh-water fish-fauna of Burma. From the results of the areas investigated by the Zoological Survey of India, *viz.*, the Inlé Lake [1] and the Indawgyi Lake,[2] it is evident that there is a considerable endemic element in the fauna, especially among the smaller forms. This conclusion applies with greater force to the inhabitants of the torrential streams. Of the 13 species of *Nemachilus* discussed here, 6 are described as new and of the remaining, 4 are endemic in Burma. Of the 3 species known from outside the political limits of Burma, 2—*N. zonalternans* and *N. sikmaiensis*—have only been recorded from the Manipur valley, the waters from which ultimately flow into the Chindwin, a tributary of the Irrawaddi River. The only remaining species—*N botia*—is widely distributed in Indian waters, but its precise specific limits have not been properly defined and in referring certain specimens from Burma to *N. botia* I have included this species in its broadly accepted sense.

Besides the species enumerated in this paper there are some doubtful forms described or recorded from Burma. In 1869, Day [3] described *N. blythii* from two specimens in the collection of the Indian Museum and remarked in his later works [4] that its locality was doubtful. These specimens are still preserved in the collection of the Zoological Survey of India but are badly damaged and are not fit for any detailed work. They are, however, entered in the register as having been obtained in Burma. Without any fresh material I am not able to characterize *N. blythii* properly and consequently to include it in the synoptic table of the Burmese species.

In 1890, Vinciguerra [5] recorded 4 species of *Nemachilus* from Burma, namely *N. rubidipinnis*, *N. rupicola*, *N. multifasciatus* and *N. savona*. I have examined the specimens on which Vinciguerra's determinations were based. There is no doubt about the first species but the other three appear to me to have been wrongly identified. Vinciguerra's *N. savona* is the same as Blyth's *N. cincticauda* and his *N multifasciatus* appears to represent a new species. I have not yet determined exactly the specific characters of Day's *N. multifasciatus* [6] and have, therefore, left out of consideration Vinciguerra's specimens referred to this species. The examples referred to *N. rupicola* by Vinciguerra are very much like those of my new species *N. rivulicola* but differ in certain points. In the absence of well-preserved fresh material I am unable to assign any exact specific position to them.

The following is an artificial key to the Burmese species of the genus *Nemachilus*. *N. peguensis* is so remarkable in the character of its funnel-shaped mouth that it could be made the type of a distinct genus, but as it is represented by a single, partly damaged specimen I have refrained from adopting this course. In its general facies and build *N. shanensis* is also very striking. *N. brevis*, *N brunneanus*, and *N. raoe* live in stationary waters and are consequently peculiarly modified.

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[1] Annandale, *Rec. Ind. Mus.*, XIV, pp. 32-64, pls. i-vii (1918).
[2] Prashad & Mukerji, *Rec. Ind. Mus.* XXXI, pp. 161-223, pls. vii-x (1929).
[3] Day, *Proc. Zool. Soc. London*, p. 552 (1869).
[4] Day, *Fish. India*, p. 621 (1878); *Faun. Brit. Ind. Fish.*, I, p. 236 (1889).
[5] Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova*, (2) IX, pp. 208-211 (1890).
[6] Day, *Fish. India*, p. 617, pl. cliii, fig. 7 (1878).

The form of *N. acuticephalus* suggests as if the fish has adapted itself to a burrowing habit. In many respects the Nemachili of Burma are a very striking and diversely modified lot.

Key to the Burmese species of *Nemachilus.*

I. A black ocellus near superior margin of base of caudal *present.* (Body finely scaled).
- A. More than 12 branched rays in dorsal (lateral line complete) .. .. .. *N. rubidipinnis* (Blyth).
- B. Less than 12 branched rays in dorsal.
  - 1. Distance between anal opening and ventral more than diameter of eye (lateral line almost complete) .. *N. botia* (Ham. Buch.).
  - 2. Anal opening close to ventral (lateral line ending below dorsal) *N. zonalternans* (Blyth).

II The black ocellus near superior margin of base of caudal *absent.*
- A. Anterior nostril in a long, flap-like tube; eye large and visible from ventral surface .. *N. brevis* Boulenger.
- B. Anterior nostril normal or slightly tubular; eye not visible from ventral surface.
  - 1. Lateral line complete or at least extending beyond ventral.
    - *a.* Lips produced into a funnel-like structure (lateral line complete) *N. peguensis*, sp. nov.
    - *b.* Lips normal, not produced into a funnel-like structure.
      - i. Length of base of dorsal almost equals length of head (lateral line complete) *N. shanensis*, sp. nov.
      - ii. Length of base of dorsal considerably shorter than head (lateral line extending to middle of anal fin).
        - α. Depth of body 6 or more than 6 times in length without caudal .. *N. sikmaiensis* Hora.
        - β. Depth of body 5 or little over 5 times in length without caudal *N. rivulicola*, sp. nov.
  - 2. Lateral line incomplete, not extending beyond ventral.
    - *a.* Commencement of dorsal nearer base of caudal than tip of snout. Pectoral shorter than head.
      - i. Ventral extending considerably beyond anal opening (lateral line terminating above pectoral) .. *N. cincticauda* (Blyth).
      - ii. Ventral just reaching or not extending as far back as anal opening.
        - α. Width of head almost equals height of head at occiput (a prominent black blotch in middle of base of caudal) .. *N. acuticephalus*, sp. nov.
        - β. Width of head considerably greater than height of head at occiput (a vertical black bar at base of caudal) .. *N. paucifasciatus*, sp. nov.

b. Commencement of dorsal nearer tip of snout than base of caudal or equidistant between the two. Pectoral longer than head.	
α. Body covered with rudimentary scales, snout more than 1·5 times diameter of eye	*N. raoe*, sp. nov.
β. Body covered with well-marked, imbricate scales, snout equal to or only slightly longer than diameter of eye ..	*N. brunneanus* Annandale.

Nemachilus rubidipinnis (Blyth).

1860. *Cobitis rubidipinnis*, Blyth, *Journ. As. Soc. Bengal*, XXIX, p. 169.
1860. *Cobitis semizonata*, Blyth, *ibid.*, p. 170.
1868. *Nemachilus rubidipinnis*, Günther, *Cat. Brit. Mus. Fish.*, VII, p. 348.
1868. *Nemachilus semizonata*, Günther, *ibid.*, p. 348.
1878. *Nemacheilus rubidipinnis*, Day, *Fish. India*, p. 614, pl. cliii, fig. 4.
1889. *Nemachilus rubidipinnis*, Day, *Faun. Brit. Ind. Fish.*, I, p. 226.
1890. *Nemachilus rubidipinnis*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova*, (2) IX, p. 208.

Blyth described two species of *Nemachilus* from Tenasserim with a long dorsal fin, *viz. N. rubidipinnis* and *N. semizonata*. Both these species were included by Günther in his *Catalogue* without any comment and were characterized after Blyth. It appears likely that Günther was greatly influenced in recognising these two as separate species by the number of rays in the dorsal fin which is stated by Blyth to be 16 in *N. semizonata* and 15 in *N. rubidipinnis*. Day obtained a specimen from Dr. Anderson of the Indian Museum, Calcutta, and described and figured it as *N. rubidipinnis* of Blyth. This very specimen appears to have been later on purchased from Day by the Indian Museum and is now preserved in our collection. It is entered in the register, No. 2680, as the type of *N. rubidipinnis* from Tenasserim. Day's figure of the specimen is of natural size and from its measurements and colouration it seems to me to be the type of *N. semizonata* and not of *N. rubidipinnis* even if the two species be considered synonymous now. The type of *N. rubidipinnis* was $3\frac{3}{4}$ inches in length, while the specimen under consideration is much smaller.

According to Blyth the main difference between the two species lies in that the body is " proportionately less deep " in *N. semizonata* than in *N. rubidipinnis*. Another peculiar character of *N. rubidipinnis* according to Blyth " consists in a short broad obtuse spine-like process projecting from the middle of the upper lip " This spine-like process of the premaxillaries is found in several species of *Nemachilus* and is usually well developed in those that possess a long dorsal fin such as *N. pavonaceous* and *N. botia*. This structure is also found in the type-specimen of *N. semizonata* referred to above. In the description of *N. semizonata*, Blyth refers to " a minute spinelet above the muzzle (as in *C. monocera*, McClelland) " I have carefully examined the type-specimen for this structure and find that it consists of a sharp, dorsally directed process of the premaxillaries, corresponding in position to the spine-like process projecting from the upper jaw, and it seems likely

that the two structures are produced in correlation to each other since this spinelet on the muzzle is present in a more or less well-developed form in all the species of *Nemachilus* with a long dorsal fin.

As regards differences in the colouration of the two species it seems probable that on account of age or as an abnormality the ground-colour of *N. rubidipinnis* was " olive-brown with a ruddy wash " in the type-specimen, whereas in the smaller specimen described as *N. semizonata* the body had " a series of twelve to fourteen dark transverse dorsal bands ", etc. I have noticed such differences in colouration among specimens of other species. The colour markings on the dorsal and the caudal fins is the same in the two species except that there is a slight variation in the number of rows. The black ocellus at the base of the caudal fin described by Blyth for his *N. semizonata* is a common character of a number of species of *Nemachilus* and especially of those that possess a long dorsal fin.

From the above it is clear that Blyth's two species from Tenasserim, *viz. N. rubidipinnis* and *N. semizonata*, are synonymous and that the differences noted between them are not of any specific value. The number of rays in the dorsal fin is, as is shown below, a variable character.

Vinciguerra, in 1890, recorded *N. rubidipinnis* from Mandalay (Upper Burma), Kokarit and Meetan (Lower Burma) and thus considerably extended the range of the species. Through the kindness of Dr. D. Vinciguerra I have with me three specimens from Fea's collection and with all this material in hand it seems worth while to redescribe this species here.

D. 3/13-17 ; P. 1/11-13 ; V 1/7 ; A. 3/5.

Nemachilus rubidipinnis is a long and slender species. The length of the head is contained 4·4 to 4·8 times and the depth of the body 5·1 to 6·1 times in the total length without the caudal. The eye is situated almost in the middle of the length of the head or somewhat in the posterior half of the head ; its diameter is contained 4 to 5 times in the length of the head, 1·5 to 2·1 times in the length of the snout and is greater than the interorbital width. The nostrils are close together and are situated nearer the eye than the tip of the snout ; the anterior nostril is tubular to a certain extent and the internarial membrane is prominent. The mouth is situated on the ventral surface behind the tip of the snout and is bordered by thick lips, the lower lip is interrupted in the middle and is raised into two button-like projections. The barbels are long and thread-like ; the inner rostral almost reaches the eye, while the outer rostral and the maxillary both extend beyond the eye. The upper jaw is produced into a beak-like process in the middle which, when the animal bites, comes in front of the lower jaw. There is a minute spinelet above the muzzle.

The body is entirely covered with distinct, imbricate scales and the lateral line is complete.

The dorsal fin originates considerably in advance of the ventral and its commencement is much nearer the snout than the base of the caudal. The base of the dorsal fin is much longer than the head. The pectoral

fin is long and pointed; it is almost as long as or slightly shorter than the head; it is separated from the ventral by a distance equal to a third of its length. The ventral fin is also long and pointed but is much shorter than the pectoral. It is separated from the anal opening by a considerable distance. The anal fin is small and does not extend to the base of the caudal. The caudal fin is almost as long as or slightly longer than the head; its posterior margin is more or less entire. The caudal peduncle is fairly stout; it is as long as or slightly longer than its depth.

The colouration according to Day is " reddish brown, with 12 to 16 irregular darkish bands descending from the back and ending in dark spots below the lateral line: 4 to 6 oblique bands on the dorsal fin: 6 to 8 irregularly vertical bars on the caudal, which has a black ocellus on the upper half of its base "

Locality.—Burma (Tenasserim, Meetan, Kokrait and Mandalay).

Measurements in millimetres.

	Tenasserim.[1]	Mandalay.		Meetan.
Total length without caudal	64·0	73·0	56·5	57·2
Length of head	14·3	15·0	12·3	12·4
Depth of body	12·5	13·4	10·0	9·3
Diameter of eye	3·2	3·0	3·0	3·2
Length of snout	5·6	6·3	5·0	4·7
Interorbital distance	3·0	2·6	2·3	2·3
Length of caudal peduncle	10·0	11·2	7·5	7·7
Least height of caudal peduncle	8·0	9·0	7·3	7·3
Length of pectoral	13·0	15·0	11·3	11·2
Length of ventral	10·1	12·3	10·5	9·5

Nemachilus botia (Ham. Buch.).

A very wide range of distribution has been assigned to *N. botia* and so far as I am aware the precise specific limits of this species have not been ascertained. In the " Gangetic Fishes " Buchanan mentions that the " Botia is found in the rivers of the north-eastern parts of Bengal " [2] and his original notes concerning the " Gangetic Fishes " show that the types of his description were obtained from the Brahmaputra River at Goalpara. However, at the present moment I am not in a position to elucidate the precise diagnostic characters of the species and, therefore, recognize it here in its usually accepted sense.

Nemachilus botia has twice been recorded from Burma. Boulenger [3] recorded it from Nampandet in the Southern Shan States and according to Annandale [4] this species is common in small streams in the hills round about the Inlé Lake. Chaudhuri [5] recorded *N. botia* from Tanja on the North-Eastern frontier of Burma. In the collection there is a fine specimen from Shatu Jup, Myitkyina and Hukong Valley frontier,

[1] Type-specimen of *Nemachilus semizonata* (Blyth) figured by Day in *Fishes of India.*

[2] Hamilton-Buchanan, *An Account of the Fishes found in the River Ganges and its branches*, p. 350 (Edinburgh: 1822).

[3] Boulenger, *Ann. Mag. Nat. Hist.* (6) XII, p. 203 (1893).

[4] Annandale, *Rec. Ind. Mus.* XIV, p. 35 (1918).

[5] Chaudhuri, *Rec. Ind. Mus.* XVI, p. 279 (1919).

collected by Dr. Murray Stuart. A number of young examples, probably referable to this species, were obtained by Dr. B. N. Chopra from the north end of the Indawgyi Lake and in small rocky streams round about Kamaing, Myitkyina District.

Nemachilus zonalternans (Blyth).

1860. *Cobitis zonalternans*, Blyth, *Journ. As. Soc. Bengal*, XXIX, p. 172.
1869. *Nemacheilus zonalternans*, Day, *Proc. Zool. Soc. London*, p. 551.
1878. *Nemacheilus zonalternans*, Day, *Fish. India*, p. 618.
1889. *Nemachilus zonalternans*, Day, *Faun. Brit. Ind. Fish.*, I, p. 232.
1921. *Nemachilus zonalternans*, Hora, *Rec. Ind. Mus.* XXII, p. 199, pl. x, figs. 3, 3*a*.

This small loach was characterized by Blyth from two specimens obtained by Major Berdmore in the Tenasserim Provinces, but his diagnosis was considered insufficient by Günther and the species was, therefore, not included in his *Catalogue*. Later on Day examined the type-specimens and gave some further particulars about the diagnostic features of the species. In 1920, I collected a large number of specimens of this species in the Manipur Valley, Assam, and in the following year described it in detail from this fresh material. A few observations were also made on the type-specimens, which, unfortunately, are now missing from the collection.

From its general facies *N. zonalternans* appears to be an inhabitant of sluggish waters and in the Manipur Valley the specimens were obtained from muddy streams or from relatively deeper streams at the base of the hills. The species can be readily distinguished by its small size and characteristic *N. botia*-like colouration. The distribution of this species, as known at present, is discontinuous but this is mainly due to the fact that the fauna of the intermediate region has not been properly investigated so far.

Nemachilus brevis Boulenger.

(Plate XV, fig. 10.)

1893. *Nemachilus brevis*, Boulenger, *Ann. Mag. Nat. Hist.* (6) XII, p. 203.
1918. *Nemachilus brevis*, Annandale, *Rec. Ind. Mus.* XIV, p. 43, pl. ii, figs. 1, 1*a*.

Nemachilus brevis was described from 3 specimens collected from the Inlé Lake at Fort Stedman. Later, Annandale obtained a large number of specimens of this species from several localities in the Inlé basin and on the He-Ho plain. In 1922, I collected some further material from the Inlé Lake and from a stream flowing out of the " White-Crow Tank " at the base of the Tongyi Hill. The species has so far been found only in still and slow-running waters and is very well adapted for this type of habitat. Its large and bulging eyes, long barbels, deep body with rounded ventral surface and its tubular anterior nostrils are all characteristic modifications in response to its peculiar habitat.

It was pointed out by Annandale that " the male differs from the female in colouration and also in the shape of the body; as a rule, instead of being merely spotted or mottled, it has on the sides a number of short black vertical bars, which sometimes fuse together to form an

irregular longitudinal bar. The bars are variable both in number and in size. The male has, further, a small cartilagenous pad immediately in front of the lowest quarter of the eye" Besides these points I find that the males are, as a rule, smaller in size and possess relatively longer fins. The black, longitudinal band along the lateral line is a striking feature of the male.

In *N. brevis* the mouth is bordered by thick lips which are continuous at the angles. The lower lip is interrupted in the middle line and its two halves are thrown into a number of folds. The upper lip is also somewhat pleated.

Measurements in millimetres.

	♀	♀	♂	♂
Total length including caudal	57·5	56·2	47·0	41·3
Length of caudal	9·0	9·2	8·0	7·7
Length of head	12·8	12·5	10·3	9·4
Depth of body	12·4	12·0	9·5	7·8
Length of snout	4·6	4·2	3·0	3·0
Diameter of eye	3·0	3·5	3·0	2·6
Interorbital distance	3·7	3·3	2·7	2·3
Length of caudal peduncle	6·5	6·0	5·5	5·3
Least height of caudal peduncle	5·3	5·0	4·2	3·4
Longest ray of dorsal	8·4	8·3	7·0	7·0
Length of pectoral	9·0	8·8	9·3	8·8
Length of ventral	7·3	7·4	7·0	6·3
Longest ray of anal	7·2	7·4	6·7	6·0

Nemachilus peguensis, sp. nov.

(Plate XIV, figs. 1, 2.)

D. 3/9; P. 1/11; V 1/8; A. 9?

Nemachilus peguensis is a small and slender species in which both the dorsal and the ventral profiles are somewhat arched. The ventral surface is flattened in front of the ventrals and the tail is compressed from side to side.

The head is pointed and its length is contained 4 times in the total length without the caudal; its greatest width is equal to its length excluding the snout; its height at the occiput is equal to half of its length. The depth of the body is contained 6 times in the total length without the caudal. The eye is situated somewhat in the posterior half of the head and the snout is longer than the postorbital part of the head; the diameter of the eye is contained 4·5 times in the length of the head, 2 times in the length of the snout and 1·1 times in the interorbital distance. The eye is not visible from the ventral surface. The nostrils are situated close to the dorso-anterior border of the orbit. The mouth is situated in a cup-shaped structure formed by the lips; it is ventral in position and is placed considerably behind the tip of the snout. The anterior lip is greatly hypertrophied and its edges are raised, forming a funnel-shaped structure; on the inner side it is lined with a sort of horny substance. The posterior lip is represented by

two thick pads which are separated along the middle line by a deep and narrow groove. Both the lips are continuous at the angles. The three pairs of barbels are well-developed, the inner rostral extends to the nostrils, the outer rostral to below the middle of the eye and the maxillary, which is as long as the outer rostral, extends beyond the eye.

The body, except on its ventral surface, is covered with minute, imbricate scales and the lateral line is complete.

The dorsal fin originates in advance of the ventral and its commencement is almost equidistant between the tip of the snout and the base of the caudal fin; its height is considerably greater than the depth of the body below it. The pectoral fin is long and narrow and is pointed posteriorly; it is not as long as the head and is separated from the ventral by a distance equal to about half its length. The ventral is similar to the pectoral and extends considerably beyond the anal opening; it is provided with a sharp, scaly appendage to its base which is adnate to the body for the greater part of its length. The specimen is damaged in the region of the anal fin and, therefore, the characters of this fin cannot be given. The caudal fin is as long as the head and is sharply divided in the last third of its length; the two lobes are equal and are sharply pointed. The caudal peduncle is fairly stout; it is almost as long as high.

In the only preserved specimen the colour is very much faded, but a large number, about 18, indistinct, vertical, black bars can be made out on the body. The fins are without any markings.

Type-specimen.—F $\frac{11057}{1}$, Zoological Survey of India, Calcutta (*Ind. Mus.*).

Locality.—Pegu Yoma, a chain of hills in Burma to the east of the Irrawaddi running due north and south.

Remarks.—There is only a single specimen of this species in the collection and even this is partly damaged in the region of the anal fin. The specimen was collected by Mr. J. P. Cook and unfortunately no information is available as to the precise habitat of the species. *N. peguensis* is remarkable in the modification of its lips, especially the anterior, which is produced upwards and forms a funnel-like structure. I am unable, at present, to discuss the exact significance of this remarkable structural modification, which alone has induced me to describe it as a new species based on a single, partly damaged, specimen.

Measurements in millimetres.

Total length excluding caudal	51·0
Length of head	12·6
Depth of body	8·2
Diameter of eye	2·8
Length of snout	5·6
Interorbital distance	3·2
Height of dorsal	11·0
Length of pectoral	11·0
Length of ventral	9·0

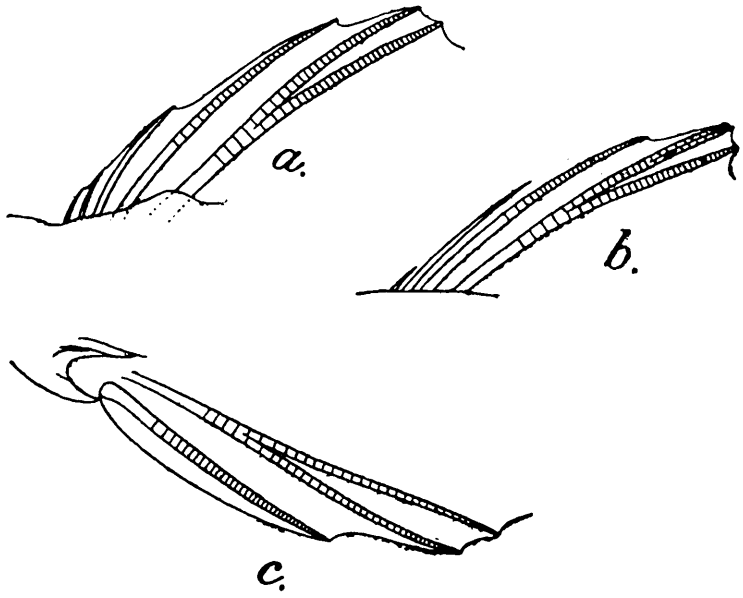
Nemachilus shanensis, sp. nov.

(Plate XV, figs. 5, 6.)

D. 4/9 ; P. 1/8 ; V 1/6 ; A. 3/6.

In *Nemachilus shanensis* the head and the anterior part of the body are somewhat depressed and the under surface is flattened. The paired fins are horizontally placed and are specially modified to serve as adhesive organs. The fish is stout, muscular and well-built.

The head is short and globular ; its length decreases proportionately with the growth of the fish as does also the depth of the body. The length of the head is contained from 4·5 to 5 times and the depth of the body 5·1 to 6 times in the length without the caudal. The eye is situated almost in the middle of the length of the head and its upper margin is slightly raised above the dorsal profile of the head ; its diameter is contained 4 to 4·2 times in the length of the head, 1·7 to 1·9 times in the length of the snout and is almost equal to the interorbital distance. The eye is not visible from the ventral surface. The nostrils are situated close together and are much nearer to the eye than to the tip of the snout. The barbels are short and stumpy ; the inner rostrals are shorter than the diameter of the eye, while the other two pairs are somewhat longer. The mouth is ventral, placed slightly behind the tip of the snout ; the lips are thick and continuous at the angle but the lower lip is interrupted in the middle line by a narrow channel. The lips leave the lower jaw and the middle portion of the upper jaw free and exposed ; the exposed portions of the jaws are covered with a thick horny layer.



TEXT-FIG. 2.—Nature and arrangement of the spines in the fins of *Nemachilus shanensis*, sp. nov. *a* = Spines of dorsal ; *b* = spines of anal ; *c* = spine of pectoral.

There are minute, indistinct scales covering the entire body. The lateral line is complete.

The dorsal fin is fairly extensive and is fan-shaped in outline ; it originates in advance of the ventral and its commencement is equidistant between the tip of the snout and the base of the caudal fin. The height of the dorsal fin is less than the length of the head, but the length of its base almost equals the length of the head. The 4 spines of the dorsal fin are enclosed in a thick membrane and appear as a single spine. The last dorsal spine is segmented distally for a greater part of its length. The membranes in between the rays are provided with skin pads. The anal fin is as high as the dorsal and its three spines are enclosed in a thick membrane, so that superficially they appear as one, the last spine is segmented distally for the greater part of its length. The anal fin is considerably removed from the anal opening and its commencement is nearer to the base of the caudal than to the origin of the ventral fin. The membranes in between the rays are thickened in their proximal halves. The pectoral fin is considerably longer than the head and extends for about two-thirds of the distance to the base of the ventral. The pectoral is pointed in the middle and the rays according to their lengths are so arranged along the outer border that the outline becomes indented. The outermost ray is simple and bears a broad and thick pad of skin anteriorly ; it is segmented for a greater portion of its length distally. The ventral fin is shorter than the pectoral and just misses the vent ; its outermost ray is modified in the same way as that of the pectoral. There is a fleshy appendage at the base of the ventral. Both the paired fins are horizontally placed, and the membranes between the rays are provided with pads of skin which are used for purposes of adhesion. The caudal fin is longer than the head and is deeply forked ; both the lobes are rounded at their extremities. The upper lobe of the caudal fin is longer and better developed than the lower. The caudal peduncle is $1\frac{1}{4}$ times as long as high.

The colouration, in spirit specimens, is characteristic of the species. There are about 8 to 9 short, broad bars along the lateral line and a few similar markings on the dorsal surface in the tail region. Anteriorly the upper surface of the body is irrorated with black spots. The upper surface and the sides of the head are gray and there is a black streak along the lateral line. The ventral surface is pale. The rays of the dorsal fin are provided with two rows of black spots ; there is also a black blotch at the base of the spines and the anteriormost ray. The caudal fin is provided with a number of vertical, black bands composed of longitudinal short bars.

Type-specimen.—F $\frac{11058}{1}$, Zoological Survey of India, Calcutta (*Ind. Mus.*).

Locality.—Thale-ú Stream near Fort Stedman, Southern Shan States, Burma.

Remarks.—There are 5 specimens of this species in the collection. They were collected by me from a rapid-running, rocky stream in March 1922. *N. shanensis* is highly modified for life in swift currents and has a very characteristic facies. It can be readily distinguished by the form of its fins and by its characteristic colouration.

Measurements in millimetres.

Total length including caudal	63·0	60·0	48·0
Length of caudal	11·5	11·5	9·8
Length of head	10·2	9·8	8·5
Depth of body	8·6	9·5	6·8
Length of snout	4·5	4·5	3·6
Diameter of eye	2·5	2·3	2·1
Interorbital distance	2·5	2·2	2·2
Length of caudal peduncle	7·0	6·6	5·5
Least height of caudal peduncle	5·5	5·5	4·2

Nemachilus sikmaiensis Hora.

1921. *Nemachilus sikmaiensis*, Hora, *Rec. Ind. Mus.* XXII, p. 201, pl. ix, fig. 4; pl. x, figs. 1, 1*a*.

Nemachilus sikmaiensis is a small loach of slender build. It inhabits shallow, rocky streams with clear and rapid-running water. The species was described from 9 specimens collected by me in the Manipur Valley (Sikmai Stream near Palel on the Burma Road) and recently Dr. B. N. Chopra obtained a large number of specimens from the Myitkyina District, Upper Burma (streams in the neighbourhood of Kamaing). The Burmese examples differ from the Assamese in having fewer bars on the body and in the markings being of a much deeper colour. The specimens collected by Dr. Chopra do not exceed 3·5 cm. in length and in none of them I have been able to distinguish the secondary sexual characters of the male.

Measurements in millimetres of Burmese examples.

Total length including caudal	33·6	32·3	30·0
Length of caudal	7·0	6·5	5·8
Length of head	6·4	6·5	5·8
Depth of body	4·3	4·1	3·6
Length of snout.	2·4	2·6	2·0
Diameter of eye	1·4	1·3	1·3
Interorbital distance	1·5	1·5	1·3
Length of caudal peduncle	2·7	2·7	2·2
Length of pectoral	5·6	6·0	5·5
Length of ventral	5·3	5·0	4·6

Nemachilus rivulicola, sp. nov.

(Plate XV, figs. 3, 4.)

D. 4/8; P. 1/10; V 1/6; A. 3/5-6.

Nemachilus rivulicola is a small and slender species which replaces *N. brunneanus* Annandale in the clear, rapid-running streams of the Inlé Basin. Annandale's *N. brunneanus*, as remarked elsewhere, is a typical sluggish water form and can be readily distinguished from the new species by its large eyes and long paired fins.

In *N. rivulicola* the head and the anterior part of the body are slightly depressed and the ventral surface in this region is flattened. The tail is compressed from side to side. The head is almost as broad as high at the occiput, its length is contained 4·1 to 4·3 times in the total length without the caudal. The eye is situated somewhat in the anterior half of the head, and is not visible from the ventral surface; its diameter is contained 3·6 to 4 times in the length of the head and 1·4 to 1·7 times

in the length of the snout. The eyes are relatively larger in the young individuals. The nostrils are situated close together, nearer to the eye than to the tip of the snout. The mouth is situated on the ventral surface slightly behind the tip of the snout and is bordered by thick lips which are continuous at the angles. The lower lip is somewhat corrugated and slightly interrupted in the middle line. There are two pairs of rostrals and a pair of maxillary barbels ; the inner rostral does not reach the eye, the outer rostal reaches to the middle of the eye, while the maxillary barbel, which is almost as long as the outer rostral, extends beyond the eye.

The body is covered with small indistinct scales. The lateral line is well-marked up to the middle of the base of the anal fin, beyond which it is not clear or is absent.

The dorsal fin originates in advance of the ventrals and its commencement is nearer the tip of the snout than the base of the caudal. The height of the dorsal fin is less than the length of the head, but is greater than the depth of the body below it. The four spines of the dorsal fin are enveloped in a thick membrane and can be made out only after a careful dissection. The pectoral fin is pointed in the middle and is almost as long as the head ; it is separated from the ventral by a distance equal to half of its length. The ventrals are considerably smaller than the pectorals and extend as far back as the anal opening ; they are provided with fleshy appendages at their bases. The anal fin commences at a distance of one and a half diameters of the eye from the anal opening and does not reach the base of the caudal fin ; it is not as high as the dorsal fin. The caudal fin is longer than the head and is forked in the last third of its length ; both the lobes are of equal size and are bluntly pointed. The least height of the caudal peduncle is contained 1·2 to 1·4 times in its length.

The colouration of the specimens before me does not vary much. The ground colour of the head and body is pale olivaceous. The dorsal surface of the head is mottled and spotted with black. There is a variable number of dark horizontal bars on the sides of the body, fairly broad behind the dorsal and anteriorly broken up into a number of narrower bars. Even in the posterior region there are indications of these bars breaking up. The dorsal fin is provided with a dark spot at its base in front and with two rows of dotted longitudinal lines on its rays. The caudal fin bears two or three faint V-shaped markings and a narrow, black, somewhat interrupted band at its base. The other fins are generally without any markings.

Type-specimen.—F $\frac{11060}{1}$, Zoological Survey of India, Calcutta (*Ind. Mus.*).

Locality.—Clear, rocky streams in the Yawnghwe Valley and the He-Ho plain, S. Shan States, Burma. I collected several specimens in a stream flowing out of a small spring near Fort Stedman.

Remarks.—It seems likely that *N. rivulicola* and *N. brunneanus* are derived from a common ancestral stock and the specific differences now noticeable between them are probably due to the divergence in their habitats. The distinctive features of both the species can be correlated with the types of environment they now inhabit.

Measurements in millimetres.

Total length including caudal	58·0	58·0	48·5
Length of caudal	12·0	12·0	10·0
Length of head	11·2	10·6	9·0
Depth of body	8·6	8·8	7·5
Length of snout	5·0	4·0	4·0
Diameter of eye	2·8	2·8	2·5
Interorbital distance	3·3	4·0	2·2
Length of caudal peduncle	6·8	7·0	6·0
Least height of caudal peduncle	5·7	5·0	4·5
Length of pectoral	10·8	11·3	9·0
Length of ventral	8·5	8·8	7·4

Nemachilus cincticauda (Blyth).

(Plate XIV, figs. 3, 4.)

1860. *Cobitis cincticauda*, Blyth, *Journ. As. Soc. Bengal*, XXIX, p. 172.
1869. *Nemacheilus cincticauda*, Day, *Proc. Zool. Soc. London*, p. 552.
1890. *Nemachilus savona*, Vinciguerra (*nec* Hamilton-Buchanan), *Ann. Mus. Civ. Stor. Nat. Genova*, (2) IX, p. 211.

Blyth characterised *Nemachilus cincticauda* as follows: "Very like *C. scaturiginea*, B. H., but with fewer rays to the dorsal and anal (*viz.* seven and six respectively), and the body more regularly banded; shewing about ten dorsal transverse bands which are broader than the alternating yellowish bands, and a strongly marked black transverse bar at base of tail,—also a dark bar between the eyes and mouth, crossing the muzzle. Two black spots on base of dorsal, and above them a black speck on each ray; the other fins without markings. Length 2 in. Tenasserim Provinces." Günther considered the above description insufficient and did not include this species in his *Catalogue*. Day, 1869, examined the type-specimen in the collection of the Indian Museum and redescribed the species in greater detail. He mentioned that the specimen, "2 inches long", was "received from Major Berdmore, who obtained it at Pegu" Later on Day described and figured a specimen from Prome as *N. cincticauda* in his *Fishes of India* and repeated this description in the *Fauna*. There are several important differences between the two descriptions and it seems certain that Day was not dealing with the same species in the two cases. Some of the salient points distinguishing the two forms are given below :—

N. cincticauda (*P. Z. S.*, p. 552, 1869).	*N. cincticauda* (*Fish. Ind.*, p. 619, 1878).
1. D. 2/7.	D. 2/8.
2. Eyes "nearly 3 diameters from the end of the snout, $1\frac{1}{2}$ diameters apart".	Eyes "2 diameters from end of snout, $1\frac{1}{4}$ diameters apart".
3. "No projection on the preorbital."	"Preorbital projecting and with a free lower edge in some but not in all examples."
4. Dorsal "commences midway between the posterior margin of the orbit and the base of the caudal fin", which "is slightly emarginate".	Dorsal "arises nearer the snout than the base of the caudal, which last is slightly forked with pointed lobes". In the figure, however, the caudal fin is deeply forked.

Besides these points there are differences in porportions, etc., of the various parts of the body. Unfortunately there is neither the type-specimen nor any other old specimen of this species in our collection and I am, therefore, unable to comment any further on the specimen described by Day as *N. cincticauda* from Prome. There are, however, two examples (Nos. 89-2-1—1666-7) in the collection of the British Museum presented by Day and stated to have been collected at Prome. These specimens are labelled *N. subfuscus ?* and are not in a very good state of preservation, but so far as can be judged they resemble *N. blythii* Day and differ considerably from *N. cincticauda* (Blyth). In the same collection there are thirteen specimens (Nos. 80-12-1—50-63) from Tenasserim presented by J. Wood Mason. They are labelled *N. savona*, but they very probably represent *N. cincticauda* Blyth.

In the collection of the Zoological Survey of India there are 6 specimens collected by Dr. F. H. Gravely at Sukli on the east side of the Dawna Hills in November, 1911. These examples agree very closely with Blyth's description of *N. cincticauda* and with Day's description of this species from the type-specimen. There is no doubt in my mind that these examples represent Blyth's *N. cincticauda* and as this species has not so far been properly understood, I take this opportunity to redescribe it in detail.

D. 2/7 ; P. 1/8 ; V 1/8 ; A. 2-3/5.

Nemachilus cincticauda is a small, but strongly built species. The head and the anterior part of the body are greatly depressed and the tail, which is very muscular, is compressed from side to side. The dorsal profile is slightly arched and the ventral is almost straight and horizontal. The ventral surface of the head and the body is flattened.

The head is considerably broader than its height and its length is contained 4·1 to 4·5 times in the total length without the caudal. The body is narrow and its depth is contained 6·1 to 7 times in the total length without the caudal. The eyes are small, dorso-laterally directed and are situated in the middle of the length of the head ; they are not visible from the ventral surface. The diameter of the eye is contained 4·6 to 6 times in the length of the head, 2 to 2·5 times in the length of the snout and 1·2 to 1·7 times in the interorbital distance. The nostrils are situated close together only a short distance anterior to the eye. The membrane between the nostrils is produced into a short, but well-marked barbel-like process. The mouth is situated on the ventral surface slightly behind the tip of the snout ; the mouth opening is lunate and is twice as wide as the diameter of the orbit. It is bordered by fleshy, crenulated lips which are continuous at the angles ; the lower lip is partly divided in the middle line. The three pairs of barbels are well developed and are of equal length ; the inner rostral extends to the front margin of the eye, the outer rostral to the middle of the eye and the maxillary extends considerably beyond the eye. There are rows of open pores on the head.

The body is covered with minute, non-imbricate scales and the lateral line is incomplete, ending before the termination of the pectoral fin.

The dorsal fin is small and originates slightly behind the ventral; its commencement is considerably nearer to the base of the caudal than to the tip of the snout; its height is greater than the depth of the body below it. The paired fins are more or less horizontally placed, the pectoral is shorter than the head and extends for about two-thirds of the distance to the ventral, which is shorter than the pectoral and extends considerably beyond the anal opening. The ventral is separated from the anal fin by a distance equal to twice the diameter of the orbit. The anal just misses the caudal, which is slightly emarginate and is almost as long as the head. The caudal peduncle is short and stout; it is almost as long as deep.

The colouration in spirit agrees with that given by Blyth. There are about 10 to 11 broad, black bands on the body, broader than the pale olivaceous interspaces between them. The base of the caudal fin is provided with a black vertical streak and there is a black blotch at the base of the anterior rays of the dorsal fin. There is an indication of a row of black spots in the middle of the dorsal fin. The other fins are without any markings. The upper surface of the head is dusky and the ventral surface dull-white.

Locality.—Lower Burma (Dawna Hills and Tenasserim Province).

Remarks.—At my request Dr. D. Vinciguerra sent me for examination the two specimens from "Thagata Juva" referred by him to *N. savona*. After a careful study I have determined them as *N. cincticauda*, but it is unfortunate that both these examples were badly damaged during transit when the material was sent to the British Museum, London, for my examination.

Measurements in millimetres.

Total length excluding caudal	46·0	43·0	38·5	35·5
Length of head	10·1	9·6	9·2	8·3
Depth of body	6·3	6·8	6·0	5·8
Diameter of eye	2·2	1·6	1·8	1·6
Length of snout	4·5	4·0	4·0	3·5
Interorbital distance	3·5	2·8	2·2	2·3
Length of caudal peduncle	7·3	5·2	6·0	5·0
Least height of caudal peduncle	5·6	5·8	5·0	5·0
Longest ray of dorsal	7·8	7·2	6·5	6·2
Longest ray of anal	7·0	6·0	5·5	5·5
Longest ray of pectoral	9·8	8·8	8·3	7·5
Length of ventral	8·8	8·0	7·0	6·7

Nemachilus acuticephalus, sp. nov.

(Plate XIV, figs. 5, 6.)

D. 3/7; P. 1/8; V 1/6; A. 2/5.

Nemachilus acuticephalus is a remarkable species as regards its general facies. It is a small and slender loach in which both the profiles are slightly arched and the ventral surface is rounded.

The head is almost cylindrical and pointed anteriorly. When the fish rests on the ground it seems probable that the ventral surface of

the head does not come in contact with the substratum. The length of the head is contained 4·5 to 4·9 times in the total length without the caudal, its greatest width equals its height at the occiput which is slightly less than the postorbital part of the head. The depth of the body in female specimens full of eggs is contained 5·3 to 5·9 times in the total length without the caudal. The eyes are minute and are situated in the anterior half of the head; they are not visible from the ventral surface. The mouth is small and is situated on the ventral surface slightly behind the tip of the snout, it is bordered by thin lips which are continuous at the angle. The lower lip is interrupted in the middle line. The nostrils are placed close together and their situation is much nearer to the eye than to the tip of the snout. The membrane between the nostrils is well developed; it lies over and entirely covers the posterior nostril and is distally produced into a short process in the middle. The barbels are thread-like, two pairs rostrals and one pair maxillary. The inner rostral extends to the nostril, the outer rostral to the middle of the eye and the maxillary extends beyond the eye.

The body is covered with small, rudimentary scales which are embedded in the skin and are hardly distinguishable. The lateral line is incomplete, it terminates in between the pectoral and the dorsal fins.

The dorsal fin is small; it originates slightly in advance of the ventral and its commencement is much nearer the base of the caudal than the tip of the snout; its height is less than the length of the head. The pectoral is much shorter than the head and extends about half way to the base of the ventral. The ventral is even shorter than the pectoral and is separated from the anal opening by a considerable distance; it is provided with a fleshy appendage at its base. The anal fin is very small and does not extend to the base of the caudal fin, which is as long as the head. The caudal fin is forked in the last third of its length, the two lobes are pointed and are almost of equal length. The rays in all the fins are cramped together and it is only with difficulty that their number in each fin can be counted. Along the dorsal surface between the bases of the dorsal and the caudal fin the skin is raised into a low ridge forming a semi-transparent adipose fin such as is found in fishes of the genus *Adiposia*.[1] A similar but much less extensive ridge occurs along the ventral surface also between the anal and the caudal fins. The least height of the caudal peduncle is contained 1·2 to 1·3 times in its length.

In the preserved specimens before me the colour is considerably faded, but still 11-13 vertical bars can be made out on the body. These bars are wider than the interspaces between them. The dorsal fin possesses a black spot at the base of its anterior rays and there is a distinctive black blotch on either side of the caudal peduncle at the base of the caudal fin. The general colouration of the preserved specimens is pale olivaceous.

Type-specimen.—F $\frac{6675}{1}$, Zoological Survey of India, Calcutta (*Ind. Mus.*).

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[1] Annandale & Hora, *Rec. Ind. Mus.* XVIII, p. 182, fig. 10 (1920).

Locality.—Hwe-gna-sang River, in the Pazi Township, of the Monglong Sub-division of Hsipaw State, Northern Shan States, Burma. The Hwe-gna-sang stream is one of the branches of the upper waters of the Madeya river, which runs into the Irrawaddi a short distance above Mandalay.

Remarks.—There are only five specimens of this species in the collection. They were obtained in May, 1911, by Dr. J. Coggin Brown of the Geological Survey of India. Of the 5 specimens 4 are females full of eggs which are of a large size, each being a little over a millimeter in diameter. The rounded and tapering head, the small and compact fins and the general facies of the species indicate that it is adapted to a burrowing mode of life. Moreover all the specimens are covered with a brownish mud which lends further support to its burrowing habits. There can be no doubt that *Nemachilus acuticephalus* is not an inhabitant of swift currents and even if it frequents such habitats it probably lives burrowed in sand or among shingles at the bottom of the stream.

Measurements in millimetres.

	♀	♀	♀
Total length including caudal	40·0	39·0	36·0
Length of caudal	6·7	7·0	6·5
Length of head	6·7	7·0	6·3
Depth of body	6·0	6·0	5·0
Length of snout	2·8	2·8	2·5
Interorbital distance	2·0	2·1	1·8
Length of caudal peduncle	4·3	3·6	4·0
Least height of caudal peduncle	3·5	3·0	3·0
Length of pectoral .	6·0	5·2	5·0
Length of ventral .	5·3	5·0	4·7

Nemachilus paucifasciatus, sp. nov.

(Plate XV, figs. 1, 2.)

D. 3/6-7; P. 1/7; V. 1/5; A. 3/5.

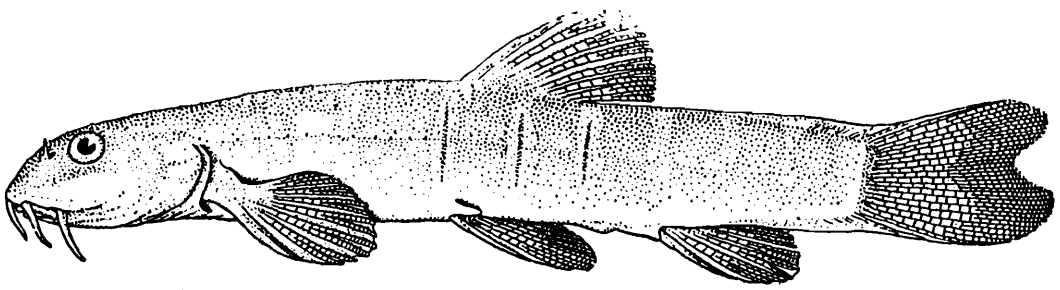
In *Nemachilus paucifasciatus* the head is depressed and the ventral surface is flat. The anterior part of the body is also somewhat depressed, but the posterior part is greatly compressed. Both the dorsal and the ventral profiles are slightly arched.

The head is broad and spatulate, its breadth equals the length of the head behind the anterior nostril and its height equals the postorbital portion of the head. The length of the head is contained from 4·2 to 4·6 times and the depth of the body 6·4 to 8 times in the length without the caudal. The eye is small and is situated nearer to the tip of the snout than to the posterior margin of the operculum; its diameter is contained from 5 to 7 times in the length of the head. The eye is not visible from the ventral surface. The nostrils are situated close together and are placed much nearer to the eye than to the tip of the snout. The membrane between the two nostrils is produced into a small, blunt projection. The three pairs of barbels are well-developed; the inner rostrals just extend as far as the nasal openings, the outer rostrals extend

to below the middle of the eyes and the maxillary barbels are slightly longer than the outer rostrals. The mouth is situated on the ventral surface slightly behind the tip of the snout. It is bordered by thick and crenulated lips which are continuous at the angles of the mouth ; the lower lip is divided in the middle. For the greater part of their lengths the lips are free from the jaws, which are covered with a horny substance. In older specimens the upper jaw is produced into a beak-like process in the middle and the lower jaw is grooved in the corresponding position for its reception. Behind the lower lip the skin is raised into a pad-like structure which probably serves as an adhesive device. There are open pores on the head arranged in definite rows. Those above and below the eyes and across the nape are continued into the lateral line, while the row on the pre-opercular and inter-opercular border ends abruptly on the side of the head.

There are small, inconspicuous scales on the body specially in its posterior half. The lateral line is fairly distinct up to the base of the ventral fin, beyond which it is absent.

The dorsal fin originates opposite the ventral and its commencement is nearer to the base of the caudal than to the tip of the snout. The height of the dorsal fin is less than the length of the head. The anal fin is not as high as the dorsal and its commencement is midway between the origin of the ventral and the base of the caudal ; it does not extend as far back as the caudal fin and is considerably removed from the anal opening. The pectoral is shorter than the head and is separated from the ventral by a distance almost equal to its own length. The ventral fin is slightly shorter than the pectoral and bears a short fleshy appendage at its base ; in young examples it just reaches the anal-opening but in older specimens it does not extend so far back. The caudal fin is shorter than the head and is notched at the end ; both the lobes are rounded. The caudal peduncle is stout and in adult specimens it is almost as high as long.



TEXT-FIG. 3.—A young specimen of *Nemachilus paucifasciatus*, sp. nov. : lateral view to show the primary colouration with indications of the bars which are so characteristic of the adult examples.

The colour varies considerably in the young and grown-up specimens. In young examples there are about 8 broad, gray bands running from the dorsal surface to the sides; these bands are separated by dull-white, narrow interspaces. A dark band of a deep colour is invariably present at the base of the caudal fin. The dorsal surface of the head is dusky. The cheeks and the ventral surface of the head and body are pale olivaceous. A dark spot is present at the commencement of the dorsal fin. With the growth of the fish the broad bands on the

body gradually fade away and the fish takes up a uniform reddish-brown tint. In the middle of the body, in the region of the interspaces, there appear narrow vertical bars of a deep reddish-brown colour. There are usually 3 or 4 such bars and they impart a very characteristic colouration to the fish. The colour band at the base of the caudal does not undergo any change and the fins do not show any markings.

Type-specimen.—F $\frac{6314}{1}$, Zoological Survey of India, Calcutta (*Ind. Mus.*).

Locality.—Hwe-gna-sang River, in the Pazi Township, of the Monglong Sub-division of Hsipaw State, Northern Shan States, Burma.

Remarks.—There are 15 specimens of this species in the collection. They were obtained by Dr. J. Coggin Brown of the Geological Survey of India in May, 1911. The adult specimens of *Nemachilus paucifasciatus* can be readily distinguished by their very characteristic colour.

Measurements in millimetres.

Total length including caudal	66·0	56·5	53·6	48·0	40·6	39·0
Length of caudal	11·7	9·2	9·5	8·2	7·0	6·8
Length of head	12·0	10·2	9·7	9·0	8·0	7·5
Depth of body	8·6	5·9	6·6	5·5	4·8	5·0
Length of snout	4·3	4·0	4·2	3·5	3·0	3·0
Diameter of eye	1·8	2·0	1·4	1·6	1·6	1·5
Interorbital distance	3·3	2·3	2·6	2·4	2·1	1·6
Length of caudal peduncle	8·8	7·0	7·3	6·3	4·8	5·8
Least height of caudal peduncle	7·8	4·9	4·8	4·8	4·0	3·8

Nemachilus raoe, sp. nov.

(Plate XV, figs. 7, 8.)

D. 4/9 ; P. 1/10 ; V 1/7 ; A. 3/6.

Nemachilus raoe is a small and slender species resembling *N. brunneanus* both in its general facies and in its body markings. The head and the anterior part of the body are somewhat depressed and the ventral surface is flattened. The tail is compressed.

The head is proportionately larger in young specimens, its length being contained 4 to 4·3 times in the total length without the caudal. The depth of the body is much less than the length of the head and is contained 5·1 to 6 times in the total length without the caudal. The eye is situated almost in the middle of the length of the head or somewhat in the posterior half ; its diameter is contained 3·9 to 4·3 times in the length of the head. The eyes become proportionately larger with the growth of the fish, a rather unusual occurrence. The snout is considerably longer than the diameter of the orbit but the interorbital width is only slightly longer than the diameter of the eye. The eye is not visible from the ventral surface. The nostrils are situated close together and are much nearer to the eye than to the tip of the snout. The anterior nostril is somewhat tubular ; the tube is produced posteriorly into a flap-like projection. The three pairs of barbels are well-marked, the inner rostrals extend to the nostrils, the outer rostrals to the eyes and the maxillaries, which are as long as the outer rostrals, extend slightly beyond the eye. The mouth is on the ventral surface, slightly behind the tip of the snout and is bordered by thick lips which

are continuous at the angles, the lower lip is papillated and corrugated and is interrupted in the middle line.

The scales are rudimentary and the body appears to be naked. The lateral line is incomplete and terminates in most cases opposite the commencement of the dorsal.

The dorsal fin is almost as high as or higher than the length of the head; it originates in advance of the ventral and its commencement is either equidistant between the tip of the snout and the base of the caudal or is nearer to the former than to the latter. The pectoral fins are longer than the head, are pointed in the middle and are separated from the ventrals by a short distance. The ventrals are much shorter than the pectorals and reach the anal opening; they are provided with fleshy appendages at their bases. The anal fin is much shorter than the dorsal and just reaches the base of the caudal fin. The caudal fin is longer than the head and is deeply forked in the last third of its length, the upper lobe is better developed than the lower. The least height of the caudal peduncle is contained 1·1 to 1·2 times in its length.

The ground colour of the head and body is pale olivaceous. The dorsal surface of the head is mottled and spotted with black. The body is marked with about 22 dark horizontal bars on the sides separated from one another by narrow interspaces. At the base of the caudal fin there are two deeply coloured short black bars on each side of the caudal peduncle. There is a black blotch at the base of the dorsal fin in front and a row of short black lines across its middle. The caudal fin is indistinctly marked in its proximal half with two or three V-shaped dark bands. The other fins are white. The outer rostral is finely dotted with black.

Type-specimen.—F $\frac{11062}{1}$, Zoological Survey of India, Calcutta (*Ind. Mus.*).

Locality.—Mongyai, N. Shan States, Burma.

Remarks.—Drs. H. S. Rao and B. N. Chopra collected six specimens of this species from a large tank full of weeds near the Inspection Bungalow at Mongyai. *N. raoe*, like its nearest ally *N. brunneanus* from the S. Shan States, is an inhabitant of sluggish waters, and it seems probable that the markings on the body adapt these species to life among weeds (protective colouration). *N. brunneanus* differs from the new species in having larger eyes, a larger and narrower caudal peduncle and in having the entire body covered with distinct scales. There are also differences in the colouration of the caudal and the dorsal fins of the two species.

Measurements in millimetres.

Total length including caudal	42·4	39·4	35·8
Length of caudal[1]	8·9	8·8	8·0
Length of head	7·8	7·5	7·0
Depth of body	5·6	5·8	5·4
Length of snout	3·2	2·8	3·0
Diameter of eye	2·0	1·8	1·6
Interorbital distance	2·2	2·1	2·0
Length of caudal peduncle	5·8	4·1	4·0
Least height of caudal peduncle	4·7	3·8	3·4
Length of pectoral	9·0	8·1	7·4
Length of ventral	6·5	6·2	5·2

Nemachilus brunneanus Annandale.

(Plate XV, fig. 9.)

1918. *Nemachilus brunneanus*, Annandale, *Rec. Ind. Mus.* XIV, p. 44, pl. ii, fig. 2.

Annandale described this slender species from the Yawnghwe Valley and remarked that " this little loach is abundant in the waters of the Yawnghwe valley and seems to be equally at home in clear hill-streams, in muddy rivers and among the weed-thickets of the Inlé Lake, in which it occurs both in the central region and in the marginal zone " I have examined Annandale's material and find that the single specimen collected by him from the Hsin Daung Chaung stream has been erroneously referred to *N. brunneanus;* it belongs to my new species—*N. rivulicola. Nemachilus brunneanus* is an inhabitant of sluggish waters; its large eyes, complete lepidosis, long and pointed paired fins and the lateral line restricted to a short distance are some of its salient features.

Measurements in millimetres.

Total length including caudal	46·7	45·0	44·6	42·0
Length of caudal	9·0	9·0	9·5	8·5
Length of head	8·0	8·7	8·3	7·5
Depth of body	7·2	7·2	7·0	6·8
Length of snout	2·8	3·3	3·0	2·6
Diameter of eye	2·5	2·5	2·6	2·5
Interorbital distance	1·8	2·0	1·3	1·7
Length of caudal peduncle	5·6	5·5	6·0	5·0
Least height of caudal peduncle	3·2	3·6	3·7	3·2
Length of pectoral	9·2	9·0	9·3	8·6
Length of ventral	6·2	6·3	6·4	5·6