

THE FISH OF CHITRAL.

By SUNDER LAL HORA, D. Sc., F.R.S.E., F.A.S.B., Assistant Superintendent, Zoological Survey of India, Calcutta.

(Plates III and IV.)

In the summer of 1929, a small party of the Zoological Survey of India was sent to Chitral to investigate the zoology and anthropology of the country. At the same time, Dr. G. Morgenstierne of Oslo, after obtaining permission and necessary facilities from the Government of India, went to Chitral to study the languages, folklore, custom and dramatic performances of the Kafirs of Kafiristan. The zoological section of the party, which worked under the leadership of Dr. B. N. Chopra, visited several places in the valley and made extensive collection of fish, besides that of other animals.

According to the Imperial Gazetteer of India,¹ Chitral is a state in the Dir, Swat and Chitral Agency of the North-West Frontier Province and lies between 35° 17' and 37° 8' N. and 71° 22' and 74° 6' E.; it has an approximate area of 4,500 square miles. The state is bounded on the north by the Hindu Kush range, on the west by Badakhshan and Kafiristan, on the south by Dir and on the east by the Gilgit Agency, Mastuj and Yasin. Generally, Chitral, like Kafiristan "consists of an irregular series of main valleys, for the most part deep, narrow, and tortuous, into which a varying number of still deeper, narrower, and more difficult valleys, ravines and glens pour their torrent waters. The mountain ranges which separate the main drainage valleys from one another are all of them of considerable altitude, rugged and toilsome."² (Pl. iv, figs. 1, 2.) The Chitral River, which is the principal river of the valley, is formed by the union of two large streams, the Lutkuh from the north-west and the Mastuj from the north-east (pl. iv, fig. 2). These streams arise along the southern slopes of the Hindu Kush and join each other about four miles above the town of Chitral. The Chitral River (Plate iii) flows almost due north and south and is joined by a number of streams along its course; these are the Rambhur and the Bomboret joining near Ayun, the Shishi joining near Drosh and the Lahozai joining near Mirkhani. At this place the river takes a south-west course and at Arnawai (or Arandu, as it is known locally) it passes out of the Chitral territory. In its lower reaches it is called the Kunar River and joins the Kabul River near Jallalabad. The banks are for the most part steep and high, but in places the river flows through a broad and fertile valley and its water is extensively used for irrigation. During summer months the river carries a very large amount of silt in suspension giving the water a distinctly reddish tint, on account of the colour of the soil over which it flows.

¹ *Imp. Gazetteer of India*, X, p. 301 (1908).

² Robertson, *The Kafirs of the Hindu-Kush*, p. 66 (London: 1896).

The tributaries of the Chitral River, such as Lutkuh and Mastuj flow through deeper valleys and amid more precipitous hills. In consequence, the nature of their beds and the swiftness of their currents correspond more closely with the torrential streams on the southern slopes of the Himalayas. A brief description of the various streams, in which collection of fish was made, is included under the list of localities (*vide infra*, pp. 283-285).

The ichthyology of Chitral proper has never been studied before, though Griffith in his travels through Afghanistan made a collection of fish in the Kunar River near Jallalabad and remarked that "The fish of the Koonur River, the largest tributary of the Kabul River, so far as I know, are all characteristic of Afghanistan, consisting of a *Barbus* with an elongated body, enormously developed fleshy lips, the lower being three-lobed, another *Barbus*, and one or two *Oreini*".¹ The two species of 'Barbus' referred to in Griffith's notes are evidently *Schizothorax labiatus* (McClelland) and *Sch. esocinus* Heckel, and the *Oreinus* is probably *O. sinuatus* var. *griffithii* McClelland, a very variable form as is clear from Dr. Chopra's collection from the Chitral Valley. Besides these three species, Dr. Chopra collected a large series of specimens of *Glyptosternum reticulatum* and of a new species of *Nemachilus*. It is probable that the two latter species are characteristic of swift currents and are not found in the Kunar River at Jallalabad, where several Indian species were also collected by Griffith in the Kabul River.

Robertson² observed that the rivers of Kafiristan "teem with fish which no Káfir could be persuaded to eat. The people declare that fish live on dirt, and shudder at the idea of using them for food, as we would shudder at the idea of eating rats" Griffith³ also noticed that "The fish of Afghanistan, except perhaps those of the valley of Peshawar, cannot be considered as administering to any extent to the food of the inhabitants. It is only about Jallalabad, and more especially along the Koonur valley, that I have seen Afghans employed in fishing. The only nets in use are common casting nets, but this method did not appear to me so successful as that of the hook and line"

Dr. Chopra also observed that "the Káfirs do not eat fish, though the Red Káfirs are now taking to it. They catch fish with their hands by feeling under stones and rocks. They also put a basket under a fall in the course of a stream (pl. iv, fig. 3) and drive fish down into it with their hands and feet working under stones and thus driving the fish out" The common cast net is also employed for catching fish, but these are all very primitive methods and show that the fish are not in much demand in the valley.

As is characteristic of the fish-fauna of any particular valley in Central Asia, the fauna of Chitral is poor in the number of species, only five having been found as enumerated above; while the number of individuals of each species, with the exception of *Schizothorax esocinus*, is very large indeed. *Sch. esocinus* is represented in Dr. Chopra's collection

¹ McClelland, *Calcutta Journ. Nat. Hist.*, II, p. 565 (1842).

² Robertson, *The Káfirs of the Hindu-Kush* p. 68 (1896).

³ McClelland, *Calcutta Journ. Nat. Hist.*, II, p. 565 (1842).

by a single specimen and is probably a casual visitor to the valley from the lower reaches of the Chitral River. The paucity of species of fish in the valleys of Central Asia is probably due to several causes, the most important of these, however, seems to be that the waters of the valleys have been colonised¹ gradually by the migration of fishes from neighbouring territories. I have already pointed out that "there is no indication in this fauna which shows that it is indigenous and that it has not been derived from the fauna of the low-lying lands of the neighbouring countries" The valleys themselves contain, as is indicated below in the short descriptions of the stations in the Chitral Valley, a fair diversity of habitats to permit a certain amount of 'ecological segregation' to take place so as to influence the production of new species; but the factors that inhibit the multiplicity of species are very powerful indeed. In the first place, access to the valleys of Central Asia to the south of the Hindu Kush is through the tempestuous torrents that flow all along the slopes of the Himalayas, and it will be admitted that the conditions of life are very exacting in these swift and turbulent waters. In consequence, *Nemachilus*, *Glyptosternum* and the Schizothoracinae are the only fish that have been able to invade the higher altitudes and establish themselves in the valleys of Central Asia. It was pointed out by Griffith (*op. cit.*) that some species of Indian fish extend in the Kabul River up to Jallalabad, to the north of which the fauna, so far as the fish are concerned, is typically Central Asiatic. It seems probable, therefore, that the small torrential streams along the southern slopes of the Himalayas form effective barriers for the penetration of sluggish-water species from India and other countries. In the Chitral Valley, there are places where *Barbus*, *Cirrhhina*, *Labeo*, etc., if introduced, would probably flourish, but in the normal course these genera have no chance to reach the valley. The species, that were able to cross the barrier, found rich feeding grounds and vast tracts of unoccupied territory. In accordance with biological laws, they multiplied and occupied every suitable niche in the environment and even though they still exhibit marked habitat preference, they developed a certain amount of tolerance for variation in the intensity of environmental factors. This can be clearly seen from the lists of species given below under each station.

The best adapted torrential fish in Chitral is *Glyptosternum reticulatum*; it feeds on insect larvae, such as the Ephemeropterous nymphs of *Iron* and Blepharocerid larvae, which live on or under rocks in very swift currents. *Oreinus*, which is confined usually to the rapids, is a bottom feeder and takes up food indiscriminately, though it seems to feed mainly on the algal matter encrusting rocks and stones in swift currents. *Schizothorax esocinus* is carnivorous, feeding on young fish and decaying flesh; while *Sch. labiatus* feeds on algae, caddis-worms and other insect larvae. Both species of *Schizothorax* live in deeper waters of large rivers and can withstand fairly swift currents. *Nemachilus choprai* lives among rocks and pebbles at the bottom and feeds on algae and insect larvae. From an ecological study of the fish fauna of three Central

¹ Hora, *Phil. Trans. Roy. Soc. London* (B), CCXVIII, p. 268 (1930).

Asiatic rivers, Nikolski¹ has shown that "there are well-marked communities of species associated with different rates of flow of rivers". It has been shown by me² that the rate of flow of water is the principal ecological factor that determines the types of association of animals in mountain streams. According to the rapidity of the current, the five Chitral species can thus be arranged in a series: *Glyptosternum reticulatum*, *Oreinus sinuatus* var. *griffithii*, *Nemachilus choprai*, *Schizothorax labiatus* and *Schizothorax esocinus*. From certain stations two or more species were collected, but it should be remembered that habitats vary sometimes within a very short distance of one another in the same environment. The five species from Chitral, though superficially they seem to live together, do not appear to compete with one another either for food or for space. The slow waters in Chitral, especially those containing a rich growth of vegetation, seem to be the haunts of young specimens and are, no doubt, the nurseries of the Chitral species.

As has been remarked by Griffith (*op. cit.*), the fish of the Kunar River are all characteristic of Afghanistan. *Sch. labiatus* is widely distributed in Afghanistan both in the Kabul and the Helmand river systems; *Sch. esocinus* is found in the Kashmir Valley and in the Kabul and the Helmand river systems of Afghanistan; *Oreinus sinuatus* var. *griffithii* is also found in the Kabul and the Helmand river systems of Afghanistan and *Glyptosternum reticulatum* has a much wider range of distribution, being found in the head-waters of the Indus, the Kabul, the Syr-Darya and the Amu-Darya rivers. The only endemic species in Chitral is *Nemachilus choprai*, which, in general facies, is very much like its congeners of Central Asia. On account of its close resemblance to *N. kashmirensis* Hora,³ a full description, with figures, of the latter species is included here to facilitate reference.

Dr. Chopra observed that the fish were most abundant at the junctions of the side streams with the main river. During my recent visit to the Tista Valley in May-June 1934, I noticed that the fish were to be found in large numbers at the junction of the Kalijhora stream with the Teesta river. During my brief stay at Kalijhora, it rained heavily and the water of the river was very muddy. The water of the Kalijhora stream was black. I was informed that the black colour was due to certain friable rocks that lie in the bed of the stream. The black stream did not mingle with the muddy water for about a hundred yards. According to the popular belief the fish like the taste of this water and in consequence gather in large numbers at the junction of the two streams. It is difficult to say, whether there is any truth in this belief or not but there seems no doubt that the small streams flowing through deep, forest-covered valleys bring down large quantities of vegetable débris and detritus with them, especially after heavy rainfall. This leads to a great increase in the available food supply and at the same time large quantities of nutrient salts, derived from the soil, are brought down with the current. Another possible factor is that the waters of the small streams, on account of the tempestuous nature of their currents, are

¹ Nikolski, *Journ. Animal Ecology* II, pp. 266-281 (1933).

² Hora, *Phil. Trans. Roy. Soc. London* (B) CCXVIII, pp. 171-282 (1930).

³ Hora, *Rec. Ind. Mus.* XXIV, p. 76 (1923).

much more highly oxygenated than those of the main stream. These are some of the possible factors that may account for the abundance of fish at the junctions of small streams with the principal river of a valley.

Reference may here be made to another observation which Dr. Chopra made in the Chitral Valley. On the 24th and 25th of July 1929, Dr. Chopra was camping between Daimali and Karakal in the Bumboret Valley. The Bumboret is a large river formed of a number of snow-fed streams; it has a rocky bed and the water is usually clear. During Dr. Chopra's stay, there was a heavy rainfall in the valley and in consequence the river was flooded. The intensity of the flood was so great that bridges were washed away down the valley and considerable damage was done. The water rose very high in the river and became turbid and muddy. These abnormal conditions must have incommoded the fish, as with the subsidence of water they were found washed along the banks in a dead or dying condition. The majority of these consisted of *Glyptosternum reticulatum* and the only other fish found on the banks was *Oreinus sinuatus* var. *griffithii*. Both the species are specially adapted to adhere to rocks in swift currents and have undergone structural modifications for this purpose; they are not capable of sustained swimming, though they can dart from rock to rock with great rapidity. It seems reasonable to presume that fishes with such habits, once dislodged from their moorings, either by the swiftness of the current, by the disturbance caused by the suspended pebbles and stones in the current or by the choking effect of muddy water in respiration, are probably carried helplessly in deep water by the flood till they are washed on the banks. A number of fishes picked up by Dr. Chopra were merely stupified and were revived by keeping in water. There are previous records of similar happenings in Central Asia and other mountainous countries. Lt.-Col. F. M. Bailey once sent me specimens of *Nemachilus* picked up by him after heavy floods from the bank of a stream in Eastern Tibet.

The following is a list of stations whence Dr. Chopra collected fish in the Chitral Valley. Short descriptions of the stations from Dr. Chopra's field notes and lists of species of fish collected at each station are given.

Sta. 1. 20th-28th June, 31st July and 1st-3rd August, 1929. Chitral or Kunar River near Chitral town.

“A large and broad river of muddy water flowing over a bed of sand and mud with some stones and boulders. The current is moderately swift and the banks are in most places steep and rocky. There is no vegetation in the water.”

- i. *Glyptosternum reticulatum* McClelland.
- ii. *Schizothorax esocinus* Heckel.
- iii. *Schizothorax labiatus* (McClelland).
- iv. *Oreinus sinuatus* var. *griffithii* McClelland.
- v. *Nemachilus choprai*, sp. nov.

Sta. 2. 1st-3rd July and 19th July, 1929. Pallarga stream about 2 miles below Kunisht (Red Kaffir village) in the Rambhur Valley.

“A small stream of clear, rapidly flowing water over stones and rocks in a somewhat north to south direction and joining the Rambhur River

almost midway between Kunisht and Rambhur. Practically no plant life in water, though some trees and shrubs on the banks, which are quite steep in places. The water is considerably warmer than that in the Rambhur River or other streams in the locality." At 12 noon on the 19th of July 1929, the temperature of water in the Pallarga stream was 71.0 F. while that of Rambhur River was only 57.0 F.

- i. *Glyptosternum reticulatum* McClelland.
- ii. *Schizothorax labiatus* (McClelland).
- iii. *Oreinus sinuatus* var. *griffithii* McClelland.

Sta. 7. 24th and 25th July, 1929. Bumboret River between Daimali and Karakal in the Bumboret valley.

"A large river formed of a number of snow-fed streams, running for the most part from south-west to north-east and joining the Rambhur River a few miles above Ayun before falling in the Chitral River. It has a very swift current of clear water flowing over stones and boulders and irrigates by means of side channels an extensive area of land." Heavy floods killed the fish and washed them up the banks.

- i. *Glyptosternum reticulatum* McClelland.
- ii. *Oreinus sinuatus* var. *griffithii* McClelland.

Sta. 8. 4th August, 1929. Lutkuh River at Sheghor.

"A very large stream of moderately swift current with water almost dark with suspended mud and clay, flowing over a more or less sandy bed, with comparatively few stones and boulders. No vegetation in the stream."

- i. *Schizothorax labiatus* (McClelland).

Sta. 9. 5th and 6th August, 1929. Lutkuh River near Hot-Springs.

"A large stream of rapid current with clear water flowing over a bed of stones and sand. No vegetation."

- i. *Glyptosternum reticulatum* McClelland.
- ii. *Schizothorax labiatus* (McClelland).
- iii. *Oreinus sinuatus* var. *griffithii* McClelland.
- iv. *Nemachilus choprai*, sp. nov.

Sta. 12. 20th-27th August, 1929. Mastuj River between Koghazi and Mastuj.

"A large river of muddy water and swift current flowing for the most part over stones and boulders, with occasional patches of sand and mud, between steep banks. No vegetation of any kind in the water."

- i. *Glyptosternum reticulatum* McClelland.
- ii. *Schizothorax labiatus* (McClelland).
- iii. *Oreinus sinuatus* var. *griffithii* McClelland.
- iv. *Nemachilus choprai*, sp. nov.

Sta. 13. 29th August, 1929. A small stream near Surguz in the Mastuj Valley.

"A stream of clear water, originating from some springs and fed by other springs along its course, with a moderately swift current flowing

over a bed of sand and stones, and with plenty of vegetation consisting of grasses and algae.”

i. *Oreinus sinuatus* var. *griffithii* McClelland.

Sta. 14. 30th August, 1929. A small stream above Charun in the Mastuj Valley.

“ The stream is fed by a number of springs along its course, has clear water with plenty of vegetation and a bottom of mud and sand with a few stones.”

i. *Nemachilus choprai*, sp. nov.

Sta. 15. 6th and 10th September, 1929. Small spring-fed streamlets between Tar and Drosk.

“ Small streams of clear water, and slow current used in some places for irrigation, with plenty of vegetation and a somewhat muddy bottom.”

i. *Glyptosternum reticulatum* McClelland.

ii. *Schizothorax labiatus* (McClelland).

iii. *Oreinus simatus* var. *griffithii* McClelland.

Sta. 16. 15th and 16th September, 1929. Ramram gol near its junction with the Chitral River below Arandu.

“ A large hill stream of clear water, with swift current flowing over stones and boulders and without any vegetation.”

i. *Glyptosternum reticulatum* McClelland.

ii. *Schizothorax labiatus* (McClelland).

iii. *Oreinus sinuatus* var. *griffithii* McClelland.

Before giving the systematic account of the collection, I wish to express here my sincerest thanks to Dr. B. N. Chopra for the valuable information he has supplied to me during the preparation of this report and for his helpful suggestions and to Dr. B. Prashad for going through the manuscript. Mr. R. Bagchi has made all the drawings, except those of *Nemachilus kashmirensis* Hora, under my supervision with great care and skill and for this I am much obliged to him.

Glyptosternum McClelland.

1842. *Glyptosternon*, McClelland, *Calcutta Journ. Nat. Hist.*, II, p. 584.
 1860. *Glyptosternon*, Blyth, *Journ. As. Soc. Bengal*, XXIX, p. 152.
 1876. *Exostoma*, Day (in part), *Fish. India*, p. 501.
 1889. *Exostoma*, Day (in part), *Faun. Brit. Ind. Fish.*, I, p. 108.
 1889. *Glyptosternum*, Vinciguerra, *Ann. Mus. civ.-stoz. Nat. Genova*, XXIX, p. 245.
 1905. *Parexostoma*, Regan, *Ann. Mag. Nat. Hist.* (7), XV, p. 182.
 1911. *Parexostoma*, Regan, *Ann. Mag. Nat. Hist.* (8), VIII, p. 564.
 1922. *Glyptosternum*, Hora (in part), *Rec. Ind. Mus.*, XXIV, p. 33 (foot-note).
 1923. *Glyptosternum*, Hora (in part), *Rec. Ind. Mus.*, XXV, p. 30.
 1923. *Glyptosternum*, Annandale (in part) *Ann. Mag. Nat. Hist.* (9), XII, pp. 573-577.
 1925. *Parexostoma*, Norman, *Ann. Mag. Nat. Hist.* (9), XV, p. 572.
 1931. *Glyptosternum*, Myers, *Lingnan Sci. Journ.*, X, p. 260.
 1932. *Glyptosternum*, Hora, *Ann. Mag. Nat. Hist.* (10), X, pp. 176-179.
 1933. *Glyptosternum*, Smith, *Journ. Siam Soc., Nat. Hist. Suppl.*, IX, pp. 70-74.
 1933. *Glyptosternum*, Berg, *Poiss. Eaux Douces, U. R. S. S.*, 3rd ed. pt. ii, p. 596.

In 1922 and more particularly in 1923, I assigned to the genus *Glyptosternum* a group of Sisorid fishes in which the structure of the paired fins agrees with McClelland's description of the fins of *G. reticulatum*. This structure is so remarkable that Blyth seems to have been greatly influenced by it in restricting the name *Glyptosternum* to *G. reticulatum*, which thus constitutes the type of the genus. Though, at the time, I was fully aware of the heterogenous nature of the assemblage I referred to *Glyptosternum*, it was not possible then to divide it into genera as the name *Glyptosternum* could not be applied to any of the forms with certainty. Regan¹ and Myers (*op. cit.*) have also indicated that until *G. reticulatum* is rediscovered and redescribed it is not possible to arrive at a satisfactory solution concerning the application of this generic name. Recently, however, I gave reasons to believe that "*Parexostoma stoliczkae*," a widely distributed species in the western parts of Central Asia, is identical with *Glyptosternum reticulatum*, and pointed out that of the several genera, into which Glyptosternoid fishes have been divided, *Parexostoma* Regan becomes synonymous with *Glyptosternum* McClelland. This supposition has received further support from the fact that McClelland's species have been rediscovered² from the Kabul River near Kabul in Afghanistan. The Surgeon to the British Legation at Kabul made a small collection of fish in the Paghman River, a tributary of the Kabul River, and this included a specimen of *Glyptosternum reticulatum* (or the hitherto well known species *Parexostoma stoliczkae*). This discovery leaves no doubt about the identity of McClelland's *G. reticulatum* described from Sir-i-Chashma, the source of the Kabul River. From within the limits of Afghanistan the species has also been obtained in the Bannu Anderab River³ of the Oxus System, about 79 miles north of Kabul. Both Smith and Berg in their recent works have upheld my views regarding the generic identity and limits of *Glyptosternum* McClelland. In view of this evidence it is now possible to split up the composite assemblage and to define the generic limits of each group. The genus *Glyptosternum* may be characterized as follows:—

The genus *Glyptosternum* comprises large-sized and greatly flattened Sisorid fishes in which the head and the anterior part of the body are depressed and the tail is compressed from side to side. The skin is soft except on the ventral surface in front of the anal-opening where it is thickly or sparsely covered with soft papillae. The eyes are minute, almost indistinguishable; they are subcutaneous and are situated on the dorsal surface of the head. The mouth is transverse and is situated considerably behind the tip of the snout. The teeth are pointed, those of the upper jaw form a band which is produced backwards at the sides. The teeth on the lower jaws form two bands which are pointed towards the sides. The fold of the lower lip is broadly interrupted. There are 8 barbels, 2 nasal, 2 maxillary and 4 mandibular; the mandibular barbels are provided with very broad bases and on the ventral surface in their

¹ Regan, *Ann. Mag. Nat. Hist.* (9), XI, p. 609 (1923). Berg (*Bull. Acad. Sci. U. R. S. S.*, p. 1267, 1931) used the name *Glyptosternum* for species of the genus *Glyptoithorax* Blyth.

² Hora, *Journ. Bombay Nat. Hist. Soc.*, XXXVI, p. 697 (1933).

³ Hora, *ibid.*, XXXVII (*in press*).

outer halves bear striated pads of adhesive skin. The gill-openings are wide, extending to the ventral surface for a short distance. The gill-membrane is broad and free throughout its length. The fins are "without spines, the first ray of the pectoral and ventral fins soft and pinnate, giving off soft, pointed cartilaginous rays along the anterior margin, which are enveloped in the membrane of the fin" The dorsal is situated above or slightly behind the pectorals, but entirely in advance of the ventrals. The adipose fin is long and low. The paired fins are broad, rounded and horizontally placed; they are vertical in their inner and horizontal in their outer halves. The skin on the ventral surface of the first ray of the paired fin is corrugated in pinnate folds for the purposes of adhesion. The caudal fin is truncate, obliquely truncate or somewhat rounded. The air-bladder is greatly reduced and enclosed in two bony capsules.

Type-species.—*Glyptosternum reticulatum* McClelland.

In view of the uncertainty prevailing about *G. reticulatum* I¹ suggested in 1923 that *G. labiatum* McClelland should be considered as the type of *Glyptosternum* instead of *G. reticulatum*. Myers² has pointed out that this suggestion is in violation of the International Rules of Zoological Nomenclature, but in view of the rediscovery of *G. reticulatum* no new genotype need be considered.

Geographical Distribution.—So far only two species are known in this genus. *Glyptosternum maculatum* (Regan) is known from Eastern Tibet (Lhasa and Gyang-tse) and Sikkim; whereas the other species *G. reticulatum* McClelland is widely distributed in the head waters of the Indus (Basgo, Sneema, Leh, Ladak and the Kashmir Valley), of the Kabul River (Sri-i-Chushmah, Julraiz³, Paghman and the Chitral Valley), of the Syr-Darya and the Amu-Darya in Eastern Turkestan (Oxus System).

***Glyptosternum reticulatum* McClelland.**

1842. *Glyptosternon reticulatus*, McClelland, *Calcutta Journ. Nat. Hist.*, II, p. 584.
 1860. *Glyptosternon reticulatus*, Blyth, *Journ. As. Soc. Bengal*, XXIX, p. 153.
 1876. *Exostoma Stoliczkae*, Day, *Proc. Zool. Soc. London*, p. 782.
 1877. *Exostoma Stoliczkae*, Day, *Fish India*, p. 502, pl. cxvii, fig. 3.
 1878. *Exostoma Stoliczkae*, Day, *Sci. Res. 2nd Yarkand Miss.* Ichthyology, p. 1, pl. i, fig. 1.
 1889. *Exostoma Stoliczkae*, Day, *Faun. Brit. Ind., Fish.*, I, p. 110, fig. 45.
 1889. *Exostoma Oschanini*, Herzenstein, *Mel. biol.*, XIII, p. 69.
 1890. *Exostoma Oschanini*, Herzenstein, *Bull. Ac. St. Petersburg*, XXXIII, p. 120.

¹ Hora, *Rec. Ind. Mus.*, XXV, p. 35 (1923).

² Myers, *Lingnan Sci. Journ.*, X, p. 260 (1931).

³ According to Day (*Ichthyology Sci. Res. 2nd Yarkand Miss.*, p. 19, 1878, foot-note), Griffith's remark (*Calcutta Journ. Nat. Hist.*, II, p. 564, 1842) regarding the most remarkable "dark coloured Loach-like *Silurus*, which is not uncommon about Julraiz" probably refers to a species of *Amblyceps*. In my revision of the genus *Amblyceps*, I have indicated (*Rec. Ind. Mus.* XXXV, p. 610, 1933) that *Amblyceps* has never been recorded from any place west of the Kangra valley. I am of opinion that in his remark about "Loach-like *Silurus*" Griffith made a reference to *Glyptosternum reticulatum* which is found in abundance at Sir-i-Chashma.

1905. *Exostoma Stoliczkae*, Berg, *Ryby Turkestana*, p. 211, fig. 31.
 1905. *Parexostoma Stoliczkae*, Regan, *Ann. Mag. Nat. Hist.* (7), XV, p. 183.
 1907. *Exostoma gracile*, Grazianov, *Trudy Otdela Ichtyologii*, IV, p. 58.
 1907. *Exostoma labrax*, Grazianov, *ibid*, p. 59.
 1908. *Exostoma stoliczkae*, Berg, *Ezhegodnik Zoologicheskago Muxeya Akademii Nauk*, XIII, p. 450 (1908).
 1916. *Parexostoma stoliczkae*, Berg, *Poiss. Eaux Douces Russie*, p. 371, figs. 289, 290.
 1923. *Glyptosternum stoliczkae*, Hora, *Rec. Ind. Mus.*, XXV, p. 37.
 1925. *Parexostoma stoliczkae*, Norman, *Ann. Mag. Nat. Hist.* (9), XV, p. 572.
 1932. *Glyptosternum reticulatum*, Hora, *Ann. Mag. Nat. Hist.* (10), X, p. 179, fig.
 1932. *Glyptosternum reticulatum*, Hora, *Cur. Sci.*, I, p. 130.
 1933. *Glyptosternum reticulatum*, Hora, *Journ. Bombay Nat. Hist. Soc.*, XXXVI, p. 697.
 1933. *Glyptosternum reticulatum*, Berg, *Poiss. Eaux Douces U. R. S. S.*, 3 ed. pt. ii, p. 597, figs. 549-551.
 1934. *Glyptosternum reticulatum*, Hora, *Journ. Bombay Nat. Hist. Soc.*, XXXVII (in press.)

From the above synonymy it is clear that *Glyptosternum reticulatum*, instead of being an obscure species as hitherto believed to be, is a well-known representative of the Sisorid group of fishes. Several authors have described it and published its illustrations under the title "*Exostoma stoliczkae*" I, therefore, do not propose to redescribe the species here, but in view of the abundant material before me from the Chitral Valley the following notes should prove useful.

Day (1876) has already indicated the remarkable variation in the comparative length of the head to that of the total length in this species. I have noticed that such a range of variation exists in the relative proportions of all the principal organs. For instance, the length of the caudal fin is contained 6.4—9.8 times in the total length including the caudal. In smaller individuals this fin is relatively longer. The head is also proportionately longer in young individuals; the length of the head is contained 4.9—6.2 times in the total length with the caudal and 4.2—5.6 times without it. The depth of the body is also variable but it is not in any way correlated with the size of the specimen; it is contained 7.3—10.5 times in the total length with the caudal. The caudal peduncle becomes proportionately longer with the growth of the fish; its least height is contained 2.6—3.4 times in its length. The increase in the length of the fins does not keep pace with the growth of the fish. In young specimens the pectorals are separated from the ventrals by a short distance, and the latter are separated from the anal by a still shorter distance. While in fully grown examples these fins are considerably removed from one another. The longest ray of the dorsal is greater than the depth of the body in specimens up to 110 mm. in length while in larger specimens it is considerably shorter than the same dimension. For further details reference may be made to the table of measurements on page 291. It seems probable that the variability of the species has led to its being described under so many different names in various parts of its extensive range of distribution.

Distribution.—It has been pointed out above (p. 287) that *Glyptosternum reticulatum* is widely distributed in the upper reaches of the Indus, the Kabul, the Amu-Darya and the Syr-Darya Rivers. Thus the species is found in Eastern Turkestan and in the mountain regions that border

it on the south and west. In the Chitral Valley, Dr. Chopra obtained 215¹ specimens from the following localities :—

- (i) 37 specimens from the Chitral River near the Chitral town (Sta. 1).
- (ii) 18 specimens from the Pallarga Stream 2 miles below Kunisht in the Rambhur Valley (Sta. 2).
- (iii) 154 specimens from the Bumboret River between Daimali and Karakal (Sta. 7).
- (iv) 2 specimens from the Lutkuh River near Hot-springs (Sta. 9).
- (v) 1 specimen from the Mastuj River between Koghazi and Mastuj (Sta. 12).
- (vi) 1 specimen from a small spring-fed stream between Tar and Drosh (Sta. 15).
- (vii) 2 specimens from the Ramram gol stream near its junction with the Chitral River below Arandu (Sta. 16).

It is clear from the above that *G. reticulatum* is found all over the Chitral Valley and that it is abundant in large rivers and streams. Dr. Chopra has observed that the species is commonly found near the junction of the side streams with the principal river of the valley. Owing to the heavy floods in the valley, a large number of fish were washed on the banks of the Bumboret River and were picked up next day in an almost dead condition.

Berg remarks that *G. reticulatum* (= *Parexostoma stoliczkae*) 'lives under stones'. Dr. Chopra has also observed that in the Chitral Valley the fish lives in fair numbers under stones and rocks. The species lives in large and clear streams with rapid-flowing current and with the bed strewn with rocks and boulders. Except for the algae and slime that cover the rocks in such situations, Dr. Chopra did not observe any vegetation in most of these streams. The nature of the food of these fishes (*vide infra*, p. 290) shows that they browse over the exposed surface of rocks where they must live under the direct influence of the swift current. So it seems probable that a bed of smooth rocks is essential for these fishes, that their feeding grounds are the exposed surfaces of rocks and that they seek shelter under rocks when frightened or when not feeding. These habits correspond very closely to those of the fishes of the genus *Garra* and other hill-stream fishes.

Sexual Dimorphism and the Proportion of Sexes in the population.—In *Glyptosternum reticulatum* the males do not possess any well-marked secondary sexual characters; but by dissecting a number of specimens, I have been able to find some difference in the region of the anus by which the sexes can be distinguished readily by a superficial examination of the specimens. Behind the anal opening, there is a deep groove. In the male a sharp, conical, well-developed papilla projects behind the anus in this groove; whereas in the females, there is no anal papilla but the anal opening is bordered laterally by two prominent lips which cover the groove behind the anus. Judging by these characters, I have been able

¹ In my note on *G. reticulatum* in the *Annals* I mentioned only 176 specimens. Unfortunately, I overlooked to count the specimens in one bottle. Four specimens have been presented to the British Museum (Nat. Hist.), two were sent to Dr. G. S. Myers and a dozen specimens to the Zoological Museum at Moscow.

to divide the 209 specimens into 122 males and 87 females. So far as can be judged by these figures, it seems that males predominate in the population; they form 58.4 per cent as against 41.6 per cent females. Of the 148 specimens from the Bumboret River (6 specimens from this locality have been presented to outside institutions) there are 78 males and 70 females giving a percentage of 52.7 males and 47.3 females. As has been indicated above, these specimens were picked up from the banks of the river after a heavy flood. In these circumstances the males and females must have been equally affected and judging from the above figures there is only a negligible higher percentage of males over the females. The figures indicate that the males and females occur in almost equal proportions. The females are probably less active and of more secretive habits than the males and this would account for the preponderance of males over females from other localities. The samples are, however, not sufficiently large to permit of any generalisation.

Bionomics.—The alimentary canal is not very much convoluted; its length is 0.94 of the total length of the fish. On an examination of the stomach-contents of about a dozen and a half specimens, it was found that the fish feeds on the flattened larvae of Ephemeroptera, such as *Iron* and other Heptageniid larvae, and the *Ephemerellid* nymphs, on the larvae and pupae of Trichoptera and the larvae and pupae of Blepharoceridae. Among the stomach-contents were a few other larvae of the *Baetis*-type (Ephemeroptera) as well as Chironomid and other highly specialised Dipterous larvae. The major part of the food consists of the Heptageniid nymphs of the *Iron*-type. All these insect larvae are specially adapted to live on or under the exposed surfaces of rocks in very swift currents,¹ in fact the Blepharocerid larvae cannot live and have not yet been found in slow currents. It is reasonable, therefore, to conclude that *Glyptosternum reticulatum* frequents exposed, smooth surfaces of rocks in swift currents for the purpose of feeding and that it also searches for the Heptageniid nymphs under stones. The relatively large size which this species attains (Day's largest example was 175 mm. in length, Berg had examples 215 mm. in length and in the present material the largest example is about 230 mm. in total length) shows that it lives in somewhat deeper waters, for large size is a distinct disadvantage in shallow waters. The fish is perfectly adapted for the type of habitat depicted above. Its flattish ventral surface can be closely applied to the hard substratum and by means of the broad, corrugated, outer ray of the paired fins it adheres to rocks. The structure of its paired fins further shows that the fish vigorously pumps out any water that flows on its under surface thus creating a negative pressure for the purposes of adhesion. The broad and reflected lips and the broad maxillary barbels with corrugations on their ventral surface help in adhesion. There is also no doubt that the papillae on the ventral surface are used for the same purpose. The large and unspecialised gill-openings show that the fish breathes continuously; but its large gill-membrane would indicate

¹ Hora, "Ecology, Bionomics and Evolution of the Torrential Fauna," *Phil. Trans. Roy. Soc. London (B)*, CCXVIII, pp. 171-282 (1930).

Measurements in millimetres.

	Sta. 2. ♂					Sta. 16. ♂		Sta. 7. ♀		Sta. 7. ♂	
	81.8 84.5 89.0 134.2 147.5					101.8 105.5		160.0 164.5		207.0 225.5	
Total length including length of caudal	81.8	84.5	89.0	134.2	147.5	101.8	105.5	160.0	164.5	207.0	225.5
Length of caudal	10.7	10.9	11.8	21.0	20.0	14.0	14.0	19.5	20.3	24.0	23.0
Length of head	16.6	16.5	17.0	26.4	29.0	20.0	21.0	28.8	30.0	38.2	36.0
Width of head in front of pectorals	14.7	15.2	16.0	25.0	28.0	19.2	19.0	27.6	29.2	34.8	36.4
Height of head at occiput	8.8	8.1	8.8	12.7	13.0	10.4	10.1	15.0	15.0	16.8	20.0
Depth of body	9.0	8.9	10.0	17.6	17.6	11.8	12.8	15.2	22.4	26.0	23.2
Length of snout	8.8	8.4	8.8	13.2	16.0	10.8	10.0	14.5	14.6	20.0	18.5
Interorbital width	5.0	4.6	6.0	8.0	9.0	5.8	5.2	9.0	8.7	10.5	11.0
Length of caudal peduncle	16.0	18.2	19.0	28.0	30.0	21.0	20.5	33.0	36.5	48.6	51.0
Least height of caudal peduncle	6.0	6.7	7.1	9.1	10.3	7.0	6.2	10.0	10.5	15.0	16.0
Longest ray of dorsal	13.2	12.0	13.5	16.8	17.2	13.5	13.2	15.0	16.0	22.2	23.0
Longest ray of anal	11.2	10.8	11.6	16.5	18.0	11.7	12.2	16.0	16.0	19.4	22.0
Length of pectoral	19.0	19.3	21.0	30.0	33.3	21.6	22.7	35.0	35.3	39.2	43.0
Length of ventral	15.2	15.0	17.0	23.6	24.5	17.7	17.2	27.0	25.6	29.2	33.3

that the respiration is initiated and carried on by its flapping movements. On rocks the fish seems to crawl with the help of its paired fins by using them alternately and it is likely that the lips and the associated structures also help during progression. Its powerful and muscular tail is no doubt used for darting movements from rock to rock. *G. reticulatum* is a bottom-dwelling fish, and is not capable of sustained swimming in swift currents. It is probable that the broad, lunate band of teeth on the upper jaw is used for rasping off from the rocks encrusting organisms of the type of Blepharocerid larvae and nymphs of *Iron*, etc. The teeth on both the jaws are sharp and pointed and are directed backwards. Between these two sets of teeth the scraped food has little chance to escape. The gill-rakers are long, broad and pointed, and are closely set; they decrease in size on the posterior gill-arches.

In 1923, I (*op. cit.*, p. 34) expressed the opinion that "*Glyptosternum stoliczkae*" and *G. maculatum* represented the less specialized members of the assemblage denominated as '*Glyptosternum*,' and from the simple nature of the lips and mouth, tooth-bands, gill-openings, paired fins and general facies I was misled to regard them as ancestral forms of Glyptosternoid fishes. Later work¹ has shown that on account of life in deeper and less turbulent waters of the Highlands of Central Asia as compared with those of the small Himalayan streams, *G. reticulatum* has assumed a mask of apparent simplicity and that its simple organisation is the result of retrogression and in no way represents a truly primitive or ancestral condition. These conclusions are borne out by the type of streams in which specimens of *Glyptosternum* were collected by Dr. Chopra in the Chitral Valley.

Local Name.—According to Dr. Chopra *Glyptosternum reticulatum* is known as *Karmatchhi* among the Kafirs.

Schizothorax labiatus (McClelland).

1842. *Racoma labiatus*, McClelland, *Calcutta Journ. Nat. Hist.* II, p. 578, pl. xv, fig. i.
 1842. *Schizothorax Ritchieana*, McClelland, *ibid.*, p. 580.
 1868. *Racoma labiatus*, Günther, *Cat. Fish. Brit. Mus.* VII, p. 162 (foot-note).
 1868. *Schizothorax ritchianus*, Günther, *ibid.*, p. 168.
 1877. *Schizothorax Ritchianus*, Day, *Fish. India*, p. 531 (foot-note).
 1877. *Schizothorax labiatus*, Day, *ibid.*, p. 532 (foot-note).

McClelland's description and figure of *Schizothorax labiatus*, though meagre and inadequate, are sufficiently clear as regards the most distinctive feature of the species—the nature of the lips. Since McClelland's original account, no observations seem to have been made on *Sch. labiatus*, owing to the fact that no specimen was hitherto available for study. The species was described from Griffith's drawing and the specimens, which were "accidentally left behind with the Ornithological portion of the collection" by Griffith, seem to have been lost in transit. McClelland's characterisation is as follows:

"Length of head greater than depth of body, and equal to a fourth of the entire length. Inter-maxillary very protractile and covered with a thick adipose integument, a thick trilobed integument to the lower jaw, cirri terminating in trident points.

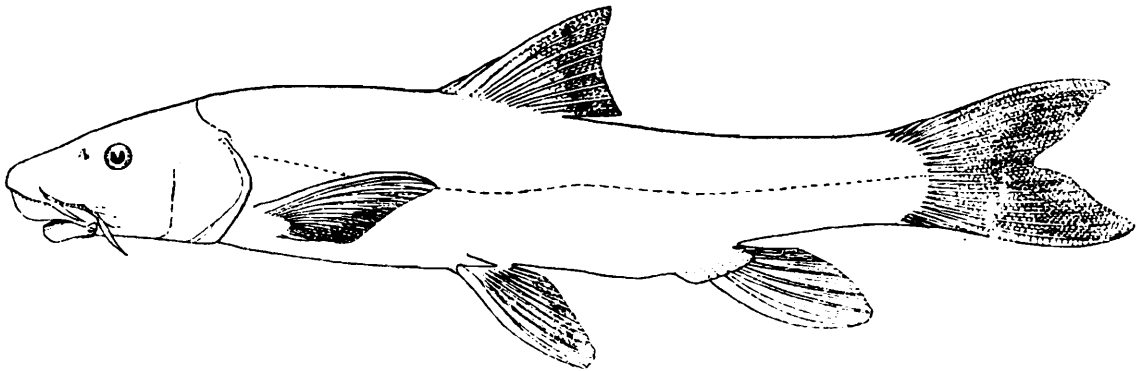
¹ Hora, *Phil. Trans. Roy. Soc. London* (B), CCXVIII, p. 237 (1930).

D. $\frac{3}{8}$: P. 19 : V. 10 : A. 7

Intestine short, disposed in $3\frac{1}{2}$ or four double folds.

Habitat.—Pashut, Koonar River near Jallalabad.—Griffith's Mss.

Mr. Griffith remarks that this singular form is nearly allied to the Lalpore species, but that the intestines of the latter are infinitely longer, nor is there any enlargement of the lips in the latter; but this last character Mr. Griffith remarks is not so remarkable in young specimens." (*Italics are mine.*)



TEXT-FIG. 1.—Lateral view of a large specimen of *Schizothorax labiatus* (McClelland) from the Pallarga stream (Sta. 2) $\times \frac{1}{4}$.

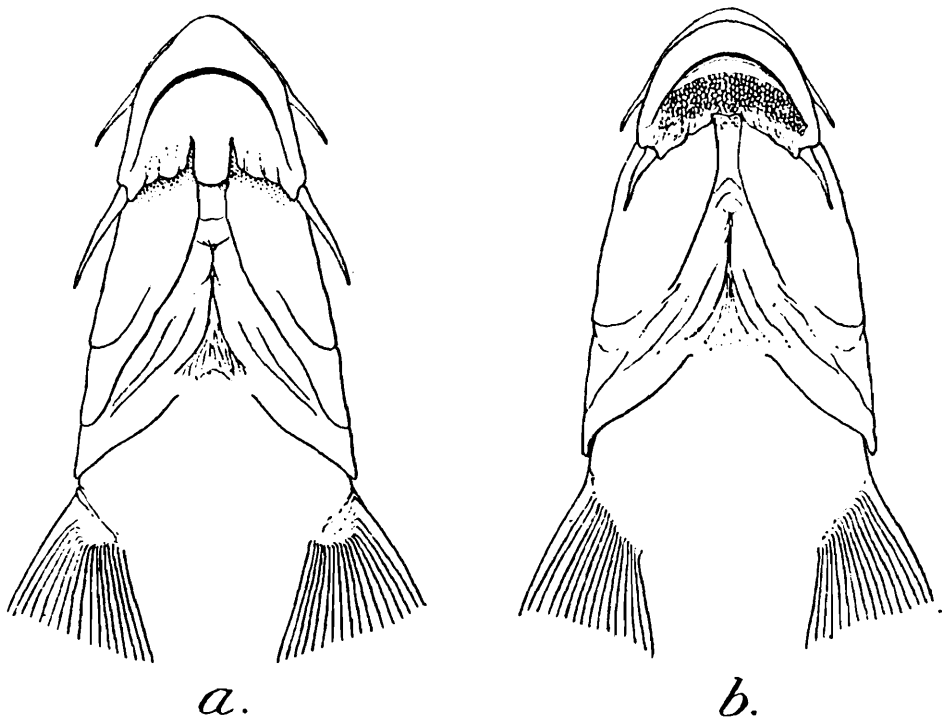
As a rule, in *Schizothorax* the lips are moderately fleshy and it is only in a few characteristic species that they are greatly enlarged. So far as I am aware the lips are hypertrophied in *Sch. regelli* Herz.,¹ of which a single specimen is known from the Amu-Darya, and in *Sch. baileyi* (Lloyd)² known from two specimens collected at Gyangtse, Tibet. Whereas in these two species the posterior lip is bilobed, in *Sch. labiatus* it is trilobed and forms a very characteristic feature of the species. In another species—*Sch. ritchieana*—described by McClelland from Afghanistan, the lower lip is trilobed. It is characterized as: "*Reflected posterior margin of the lower lip trilobate; lips broad, round and soft; width of the mouth equal to about $\frac{1}{2}$ the length of the lower jaw; which is narrow at the apex; snout narrow and compressed; dorsal spine large, scales very small, lateral line raised, body spotted.*" (*Italics are mine.*) In a large series of specimens collected by Dr. Chopra from the Chitral Valley, there are quite a number of specimens in which the lower lip is greatly enlarged, whereas in the majority of specimens the lips are of the *ritchieana*-type. Moreover, all possible gradations are found in the collection before me between the two types of lips. Fortunately McClelland sent a specimen of *ritchieana* to the Museum at the India House whence it was transferred to the British Museum and later served for Günther's description of the species in the *Catalogue*. The Chitral specimens agree with Günther's description and there seems to me no doubt that *Sch. labiatus* and *Sch. ritchieana* are synonymous. Both

¹ Herzenstein, *Fische*, in *Wiss. Res. Przewalski Central-As. Reis. Zool.*, III, pl. ix, fig. 1. According to Berg (*Poiss. Eaux Douces U. R. S. S.* 3rd Ed., pt. 1, p. 458, 1932), *Sch. regelli* is a synonym of *Sch. fedtschenkoi* Kessler and that the enlarged lips are of the nature of secondary sexual characters of the male. In *Sch. labiatus* both sexes possess enlarged lips.

² Lloyd, *Rec. Ind. Mus.*, II, pl. xxv, fig. 2 (1908).

McClelland and Günther observed that in the Helmand River examples the dorsal spine is relatively small. The Chitral collection shows that the dorsal spine is very variable in this species. In certain examples it is strong and well developed, whereas in others it is rather feeble and flexible. But in every case, it is conspicuously serrated posteriorly.

Day included *Sch. labiatus* in the group of species characterized by the "Lower labial fold interrupted", but this is obviously wrong.



TEXT-FIG. 2.—Ventral surface of head and anterior part of body in two specimens of about equal size of *Schizothorax labiatus* (McClelland) showing variation in size and form of lower lip; etc., $\times \frac{2}{3}$.

a. True *labiatus* type; b. *ritchiana* type.

In a number of young specimens it is observed that the condition of lips and jaws is intermediate between *Schizothorax* and *Oreinus*. Such a condition appears to have resulted from hybridisation (*vide infra* p. 307).

McClelland, on the observations of Griffith, stated that *Sch. chrysochlora* has much in common with *Sch. labiatus*. The resemblance is probably closer with the specimens of *Sch. labiatus* in which the lower lip is not well developed. The two species can, however, be readily distinguished by the following features:—

In *Sch. labiatus* the body is more slender and the head is considerably pointed; the labial fold is well developed and prominently trilobed; the commencement of the dorsal fin is almost midway between the tip of the snout and the base of the caudal fin, and the anal scales are very small, considerably less than half the diameter of the eye.

Schizothorax labiatus may be redescribed as follows:—

D. $3\frac{1}{8}$; A. $3\frac{1}{5}$; P. 18-20; V 11-12; C. 20.

Schizothorax labiatus is a narrow, elongated species in which the body is subcylindrical and both the profiles are slightly arched. The ventral

surface of the head and the anterior part of the body are flattish. The head is large and pointed anteriorly ; its length is contained 3.7—4.4 times in the total length without the caudal. The width of head is almost equal to its height at the occiput and is contained 1.6—1.7 times in the length of the head. The snout is smooth, but in some specimens it is studded with sharp, wart-like protuberances. These structures are usually characteristic of the males but certain ripe male specimens were without them. The eyes are placed laterally slightly below the dorsal profile of the head and are not visible from the ventral surface ; they are situated in the middle of the head or slightly nearer to the tip of the snout than to the posterior margin of the operculum. The diameter of the eye is contained 5.3—7.6 times in the length of the head, 2.1—3.3 times in the length of the snout and 1.7—2.5 times in the inter-orbital width. The interorbital space is flattish and is marked with a short, longitudinal bony ridge in the middle with two other low ridges on the sides. The mouth is inferior, horizontal and greatly arched ; it is bordered by thick and fleshy lips which are continuous at the angles of the mouth. The lower lip is trilobed, the side lobes are free while the middle lobe is only free at the tip. The structure of this lip is subject to great variation as indicated above (*vide supra*, p. 293). The lower jaw is sharp, shovel-like and covered with a thick, horny sheath. There are two pairs of well developed barbels which are longer than the diameter of the eye. The gill-openings are moderately extensive.

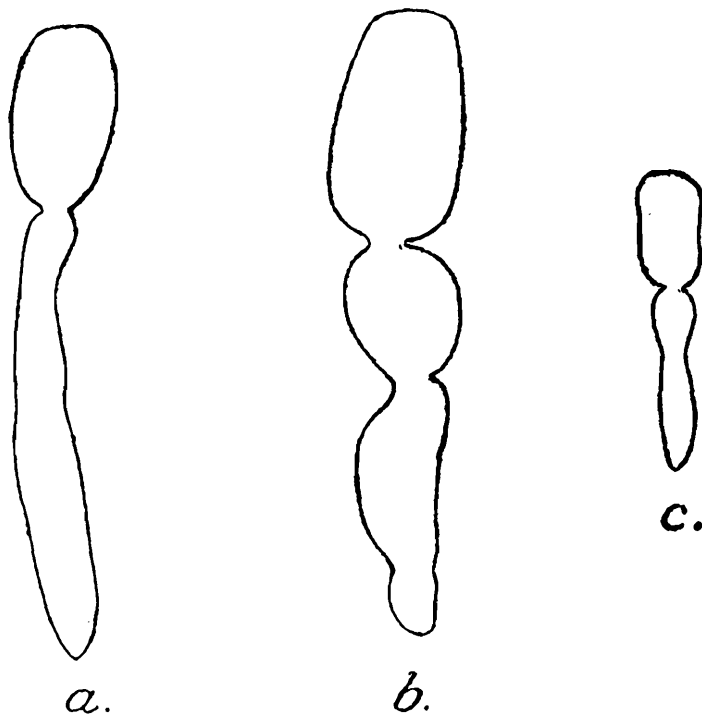
The depth of the body is contained 4.4—5.6 times in the total length without the caudal ; it is covered with small scales which are inconspicuous on the ventral surface in front of the ventral fins. The lateral line is slightly raised and there are about 107 scales along it and 28 rows between it and the base of the dorsal spine. The tiled row of anal scales is rather indistinct ; the largest scale being less than half or about half the diameter of the eye.

The commencement of the dorsal fin is opposite to that of the ventral and is almost equidistant between the tip of the snout and the base of the caudal fin. The dorsal spine is strong and horny or feeble ; its length in middle-sized specimens is contained 1.0—1.2 times in the length of the head. In older specimens the spine is proportionately shorter, its length being contained 1.6 times in the length of the head. The spine is strongly serrated posteriorly. The posterior margin of the dorsal fin is slightly emarginate. The pectoral fin is shorter than the head and its outermost ray is the longest ; it is separated from the ventral by a considerable distance. The anal opening is situated at the base of the anal fin and is considerably removed from the ventral fin. The anal fin, when laid flat, does not reach the caudal fin. The caudal fin is deeply emarginate. The caudal peduncle is strong and muscular ; its least height is contained 1.5—1.9 times in its length.

In very young specimens the body is marked with short, black streaks. In half-grown and adult specimens the body is uniformly silvery with a slightly darker tint on the dorso-lateral surface of the body.

Air-bladder.—The air-bladder of *Schizothorax labiatus* shows considerable variation as regards the form of the posterior chamber. In adult examples the walls of the bladder are thickened, fibrous and

inelastic. The anterior chamber is of the normal Cyprinoid form, whereas the posterior chamber is long and narrow. In one specimen the posterior chamber was found to be constricted in two places asymmetrically so that the bladder appeared four chambered. In a young specimen the posterior chamber was slightly narrowed in the middle. Similar variations also occur in the bladder of *Oreinus sinuatus* var. *griffithii*. The significance and the probable mode of origin of these abnormal types of bladders are discussed below (*vide infra*, p. 304).



TEXT-FIG. 3.—Air-bladders of 3 specimens of *Schizothorax labiatus* (McClelland) showing variation in form and structure. $\times \frac{3}{2}$. The thickness of the lines roughly indicates the thickness of the walls of the different chambers.

a. Normal type; from a specimen 350 mm. in length.

b. An abnormal four-chambered air-bladder from a specimen 325 mm. in length.

c. Air-bladder of a young specimen 160 mm. in length.

Distribution and Habitat.—*Schizothorax labiatus* was described from the Kunar River near Jallalabad, but the form *ritchiana* was stated to be fairly common in Afghanistan. Dr. Chopra's collection shows that the species is very common in the Chitral River and its tributaries. Specimens were obtained from the following localities:—

- (i) 1 large specimen from the Pallarga stream, 2 miles below Kunisht in the Rambhur Valley (Sta. 2).
- (ii) 6 specimens collected at Chitral in August 1929.
- (iii) 47 specimens from the Lutkuh River at Sheghor (Sta. 8).
- (iv) 1 specimen from the Lutkuh River near Hot Springs (Sta. 9).
- (v) 21 specimens from the Mastuj River between Koghzai and Mastuj (Sta. 12).
- (vi) 28 very young specimens from a small stream between Tar and Drosh.
- (vii) 11 specimens from Ramram gol near its junction with the Chitral River below Arandu (Sta. 16).

The larger individuals were obtained from rivers with swift current and rocky bed whereas the young specimens were collected in small streams. In young specimens the character of the lower lip is not so well developed as has already been remarked by Griffith. Both *Oreinus* and *Schizothorax* prefer large rivers with or without backwaters; the former is confined to these habitats whereas the latter occurs in lakes also. *Schizothorax* lives in rapids under stones and rocks.

Bionomics.—In young specimens the alimentary canal is about 1.5 times the total length of the fish and in a specimen about 300 mm. in length it was 2.3 times the length. The stomach was empty in most of the specimens dissected which suggests not only that feeding is intermittent but that the digestive action is fairly rapid. The alimentary canal was full of grayish pulp and pieces of gravel. It seems likely that *Schizothorax* feeds on caddis-worms, algae and insect larvae. The shorter length of its intestine shows that it is more carnivorous in its feeding habits than *Oreinus*. It seems likely that the broad lips of *Sch. labiatus* are spread out and applied to rocks for adhesive purposes. The horizontal paired fins and the flattish ventral surface are no doubt used for this purpose. The pointed and subcylindrical body of the fish is well adapted to offer less resistance to the rushing currents.

Measurements in millimetres.

Total length excluding caudal	184.5	215.0	243.0	262.0	350.0
Length of caudal	41.0	53.0	57.0	55.5	78.0
Length of head	42.5	51.0	58.3	59.0	93.0
Width of head	25.0	29.2	37.0	35.0	57.0
Height of head at occiput	26.5	30.3	37.8	37.0	54.0
Length of snout	17.0	21.0	23.0	26.0	41.3
Diameter of eye	8.0	8.0	10.0	8.4	12.2
Interorbital width	13.5	16.0	21.0	20.3	30.5
Depth of body	37.6	37.8	55.0	53.0	68.5
Length of dorsal spine	38.3	41.0	47.0	50.0	56.0
Length of pectoral	31.4	40.0	43.2	46.0	67.3
Length of ventral	30.6	37.6	41.5	42.0	63.0
Length of caudal peduncle	19.0	21.6	30.0	28.0	36.8
Least height of caudal peduncle	40.5	40.0	46.0	52.0	66.7

Schizothorax esocinus Heckel.

1838. *Schizothorax esocinus*, Heckel, *Fische aus Caschmir*, p. 48, pl. ix.
 1842. *Schizothorax esocinus*, McClelland, *Calcutta Journ. Nat. Hist.*, II, p. 579.
 1844. *Schizothorax esocinus*, Heckel, *Fische Kaschmir*, p. 372, 3 figs.
 1868. *Schizothorax esocinus*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 166.
 1876. *Schizothorax esocinus*, Day, *Proc. Zool. Soc. London*, p. 785.
 1876. *Schizothorax punctatus*, Day, *ibid.*, p. 785.
 1877. *Schizothorax esocinus*, Day, *Fish. India*, p. 533, pl. cxxiii, fig. 4.
 1877. *Schizothorax punctatus*, Day, *ibid.*, p. 532, pl. cxxiii, fig. 3 (foot-note).
 1878. *Schizothorax esocinus*, Day, *Sci. Res. 2nd Yarkand Miss.*, Ichthyology, p. 4, pl. i, fig. 4.
 1878. *Schizothorax punctatus*, Day, *ibid.*, p. 4, pl. 1, fig. 3.
 1889. *Schizothorax esocinus*, Day, *Faun. Brit. India, Fish.*, I, p. 254.
 1889. *Schizothorax punctatus*, Day, *ibid.*, p. 252 (foot-note).
 1910. *Schizothorax esocinus*, Zugmayer, *Zool. Jahrb.*, XXIX, p. 277.
 1916. *Schizothorax esocinus*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (3), VII, p. 20.

Both Zugmayer and Vinciguerra have referred at some length to the discrepancies in Day's descriptions, and to the inaccuracies in his drawings of *Schizothorax punctatus* and *Sch. esocinus*. From an examination of specimens in their possession they came to the conclusion that the two species are identical. The Zoological Survey of India possesses the originals of Day's figures of these two species, and a comparison of the specimens shows that Day, who probably did not possess a large series of specimens of *Sch. esocinus* to study its range of variation, had some justification to regard them as belonging to two species. Besides the differences in the general facies of the two specimens clearly shown in Day's delineations, they differ in the form and proportion of the head, the nature of the jaws, the extent and form of the mouth opening and the way in which the bones of the hyoid arch lie on the ventral surface of the head. The following table of measurements shows some of the salient differences between the two specimens:—

Measurements in millimetres.

	<i>Sch. esocinus.</i> (No. 678).	<i>Sch. punctatus.</i> (No. 511).
Total length excluding caudal	170.5	192.0
Length of head	46.0	59.5
Width of head	23.0	26.3
Height of head at occiput	23.7	30.0
Greatest diameter of eye	8.0	10.2
Interorbital width	13.2	19.3
Length of snout	15.5	20.8
Depth of body	32.2	34.2
Length of rostral barbel	10.0	9.0
Length of maxillary barbel	12.0	8.0
Length of caudal peduncle	30.0	35.0
Least height of caudal peduncle	16.0	17.2

Day's illustrations are inaccurate in several respects and it seems probable that he drew up his descriptions from the figures without reference to the specimens, otherwise it is not possible to believe how his descriptions could be so faulty and misleading. *Schizothorax esocinus* seems to vary considerably and when a number of specimens are examined the differences noted above between the two forms are bridged over. Sufficient material is not available to decide whether these differences are in any way related to the sexes of the individuals. Berg¹ has indicated that in the case of *Sch. fedtschenkoi* Kessler there may be great structural differences between the two sexes.

Griffith obtained specimens of *Sch. esocinus* in the tributaries of the Helmand and the Kabul Rivers in Afghanistan. In the Chitral Valley the fish is said to be very rare; it is represented by a single specimen which was collected by Dr. Chopra from the Chitral River near the Chitral town. Dr. Chopra informs me that he made special efforts to obtain more specimens of this species but without any success. This example represents the typical *esocinus* of Day and in it the length of the head is

¹ Berg, *Abhandlungen der Pamir Expedition 1928*, VIII, p. 23, pl. ii, figs. 1 and 2.

contained 3.6 times in the total length without the caudal. The height of the head at the occiput is almost equal to the width of the head which is nearly half the length of the head. The diameter of the eye is contained 6.5 times in the length of the head, 2.2 times in the length of the snout and 1.9 times in the interorbital width. This specimen is about 275 mm. in length, but Dr. Chopra was informed that the species grows to a much larger size and is a very good eating fish. In comparison, it is considered to be a better fish for eating than other species of *Schizothorax* and *Oreinus* commonly met with in Chitral. In spite of its qualities of flesh, the local people consider it a foul feeder. The stomach contents of the Chitral example consist of a semi-digested young specimen of *Schizothorax* and plenty of dark-coloured gravel and sand. It is likely that this species lives in pools and puddles where it feeds on dead animal matter deposited at the bottom. Its jaws are somewhat protrusible so that it can probe about in the mud and suck in food mixed with gravel like some of the typical Cyprinid fishes. Enough material is not available, however, to make any detailed observations on the bionomics of this species.

Besides the specimens referred to above there are five other examples of *Schizothorax esocinus* from Kashmir in the collection of the Zoological Survey of India. These specimens were obtained in June-July 1921 by the Kashmir Survey Party. Of these, 3 comparatively young specimens up to 135 mm. in total length were obtained in the Jhelum River at Srinagar, one from Wular Lake and a large one from Gandarbal. These specimens show that the head is relatively longer in younger individuals ; its length being contained 3.3—3.6 times in the total length without the caudal. The depth of the body is very variable, being contained 4—5.6 times in the length without the caudal. The eyes are relatively much larger in the young specimens ; the diameter of the eye is contained 4.5—7.6 times in the length of the head, 1.5—2.5 times in the length of the snout and 1.2—2.1 times in the interorbital width. The caudal peduncle is narrower and longer in larger specimens, the least height of the caudal peduncle is contained 1.7—2.1 times in its length. The fins are nearer to one another in young specimens whereas in grown-up individuals they are situated more widely apart. The osseous and serrated ray of the dorsal fin is always longer than the postorbital part of the head ; it is proportionately longer in the young specimens. The longest ray of the dorsal fin is contained 1.2—1.7 times in the length of the head. The young specimens are generally marked with largish black spots, while the larger specimens are covered with numerous black marks. The example from Chitral as well as the smallest specimen from Kashmir are without any marking. They are grayish above and silvery on the sides and below.

Remarks.—In describing *Schizothorax punctatus* Day referred to "*Racoma nobilis* McClelland" (*op. cit.*, p. 577), and remarked that it "has more fleshy lips, while the mouth appears more transverse, as in *Oreinus*, and the under jaw much the shorter" McClelland had no specimen of the species, but described it from Griffith's drawing. Day's remarks are also based on this illustration. *Schizothorax nobilis* is said to grow to a large size (18 inches) and its habits of preying on small fish

and feeding on offal show that it may prove to be identical with *Sch. csocinus*. Its body and fins are covered with spots as is usually the case in *Sch. esocinus*.

In the following table I give the measurements of the Chitral example as well as of the five specimens from Kashmir :—

Measurements in millimetres.

	Chitral.	Jhelum River.			Wular Lake.	Gandarbal.
Total length without caudal	224.2	95.0	107.3	110.3	191.0	273.0
Length of head	62.2	28.5	32.0	33.0	54.0	76.5
Width of head	31.5	13.3	18.3	16.3	26.0	39.5
Height of head	31.3	15.2	19.0	18.0	31.0	41.6
Diameter of eye	9.5	6.0	7.0	6.0	8.0	10.0
Length of snout	21.6	9.0	10.8	10.4	18.6	25.0
Interorbital width	18.5	8.0	8.8	8.2	14.0	21.0
Depth of body	43.5	20.3	26.8	23.3	37.5	48.0
Longest ray of dorsal	38.0	20.2	23.0	27.2	32.0	42.5
Longest ray of anal	34.0	15.1	18.3	20.3	27.2	40.0
Length of pectoral	38.2	16.6	18.8	19.2	29.0	39.2
Distance between pectoral and base of ventral.	25.5	11.6	13.3	14.0	23.0	34.3
Length of ventral	35.5	15.7	17.2	20.0	26.2	37.0
Distance between ventral and base of anal.	17.0	7.3	10.5	8.0	21.2	26.5
Length of caudal peduncle	41.0	15.7	19.0	18.7	31.0	52.0
Least height of caudal peduncle	23.5	9.0	11.0	11.0	17.0	24.0

***Oreinus sinuatus* var. *griffithii* McClelland.**

1842. *Oreinus Griffithii*, McClelland, *Calcutta Journ. Nat. Hist.*, II, p. 581.

1842. *Oreinus maculatus*, McClelland, *ibid.*, p. 580.

1868. *Oreinus griffithii*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 160 (foot-note).

1868. *Oreinus sinuatus*, Günther (in part), *ibid.*, p. 161.

1933. *Oreinus sinuatus* var. *griffithii*, Hora, *Journ. Bombay Nat. Hist. Soc.*, XXXVI, p. 700.

1934. *Oreinus sinuatus* var. *griffithii*, Hora, *ibid.*, XXXVII (in press).

In his account of the fish of Afghanistan in Griffith's collection, McClelland recorded specimens of the genus *Oreinus* from the head of the Ali Musjid stream (Khyber Pass), Kabul River, Gandamak, Pashat and Girdun Dewar. The examples from the Helmand River (Girdun Dewar) were referred by him to *O. plagiostomus* Heck., while those collected at Pashat (Kunar River) were described as *O. griffithii*. The young specimens obtained in the Kabul River, Ali Musjid stream and at Gandamak were designated *O. maculatus*, a species described by McClelland from the Simla Hills. From Günther's *Catalogue* it appears that no specimen of *O. griffithii* passed into the collection of the British Museum and consequently Günther could not define its exact specific limits as the description is meagre and defective. The species was, therefore, referred to in a foot-note as a doubtful form. *O. plagiostomus* was characterized by Günther on Afghanistan specimens (1 stuffed adult from Jallalabad and skins of one adult and one half-grown from Helmand River), while McClelland's young specimens of *O. maculatus*

from Gandamak were referred by Günther to *O. sinuatus*. Day in the *Fishes of India* (pp. 529-531) followed Günther's views, but in referring to *O. griffithii* under the description of *O. plagiostomus* made the following remark: *O. griffithii* "is said to differ but little from the above, its intestine are six times the length of the body, its *habitat* is Afghanistan, Koonur river, Pushut" It would thus appear that since the publication of the description of *O. griffithii* McClelland, it has not been possible for later workers to elucidate its exact systematic position. This was due to the fact that so far no specimens of the species were available for examination.

Dr. Chopra obtained a large series of specimens of a species of *Oreinus* in the Chitral Valley and though it differs but little from *O. sinuatus*, there are features which, in the present state of our knowledge of the genus, warrant separation of the two forms. Fortunately specimens have also become available from the Paghman River and Sir-i-Chashma (Kabul River) for comparison and these have made it clear that the Chitral *Oreinus* is also found extensively in the Kabul River and its tributaries in Afghanistan. It may be mentioned that Kunar River (or Chitral River), the type-locality of *O. griffithii*, is the principal river of the Chitral Valley whence Dr. Chopra obtained abundant material of the species.

Oreinus griffithii was briefly characterized by McClelland as follows: "The breadth of the mouth is equal to half the length of head, and of the interval from the extremity of the snout to the commencement of the pectorals. Dorsal spine large, vertical scales at the anal obsolete, posterior margin of the operculum round, snout smooth.

D. $\frac{4}{8}$: P. 20 : V 11 : A. $\frac{1}{8}$: C. 19.

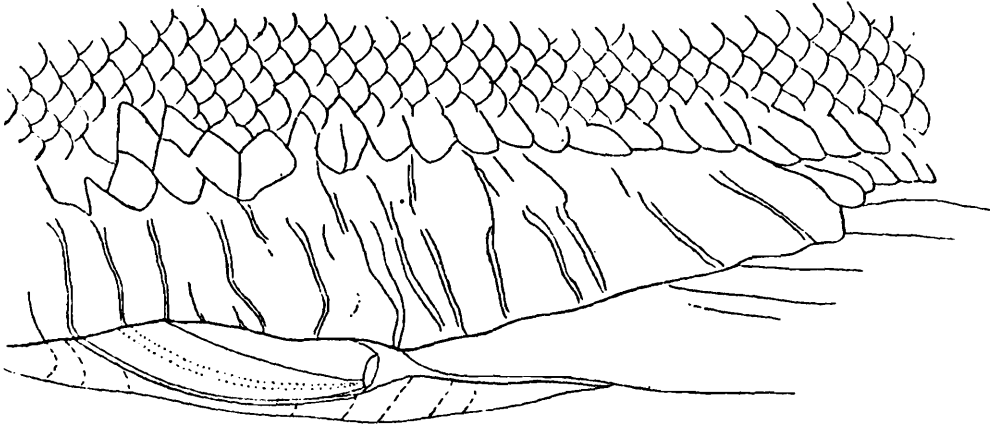
The intestines are six length of the body, and contain a brownish pulp. (Griffith.)

This species although perfectly distinct, differs but little in appearance from *Oreinus plagiostomus*.

Habitat.—Afghanistan, Koonur river, Pushut. (Griffith.)"

The reference to *O. plagiostomus* in the above description seems to have been partly responsible for our ignorance of *O. griffithii*. According to McClelland, the breadth of the mouth of *O. plagiostomus* "is equal to a third of the length of the head, and of the interval from the extremity of the snout to the pectoral fins"; the dorsal spine is "slender and soft" and the "vertical scales at the base of the anal are rather large" Günther's and Day's descriptions of *O. sinuatus*, to which *O. griffithii* is closely allied, and of *O. plagiostomus* show that the main differences between the two species lie in the character of the dorsal spine and the size of the anal scales. In the Schizothoracinae these characters are of great diagnostic value and are usually employed in distinguishing genera. Judging by these features, most of the specimens in Dr. Chopra's collection agree with *O. sinuatus* but there are two specimens, one 260 mm. long without the caudal from Pallarga stream in the Rambhur Valley and

the other 325 mm. long without the caudal from the Mastuj River between Koghazi and Mastuj, in which the anal scales are well developed and are as large as or larger than the diameter of the eye. The dorsal spine is of the nature so characteristic of *O. sinuatus*, and in other respects also they correspond with the remaining specimens. It is not possible to account for this variation as there are no gradations in the large series before me, and in the present state of our knowledge it would be better to consider them as abnormalities.



TEXT-FIG. 4.—Enlarged anal scales of a specimen of *Oreinus sinuatus* var. *griffithii* McClelland from the Pallarga stream. $\times 2$. The scales are very thin and their outlines are not well defined.

It has been indicated above that *O. griffithii* very closely resembles *O. sinuatus* in its general facies, but differs in having somewhat finer serrations on the dorsal spine, in the shorter length of the spine and in the fact that all the fins, especially the anal, are shorter. The vertical anal scales are obsolete in *O. griffithii*, with the exception of the two specimens noted above, whereas in *O. sinuatus* the scales, though small, are fairly well marked and distinct. In view of these differences it seems desirable to treat *O. griffithii* as a distinct form, for the time being at least, and at the same time to express its close affinity to *O. sinuatus*. For these reasons, I have regarded *griffithii* as a variety of *sinuatus*.

There can be hardly any doubt that *Oreinus* is a specialized form of *Schizothorax* and that the evolutionary steps by which this modification has been brought about are not very difficult to comprehend. In fact, it is very difficult to distinguish the young of *Oreinus*, at least in the earlier stages, from those of *Schizothorax*. This difficulty is further augmented by a hybridization between *Schizothorax* and *Oreinus* which, as Dr. Chopra's collection shows, is a very common occurrence in nature and results in the production of forms intermediate between *Schizothorax* and *Oreinus*. I refer to this phenomenon later (*vide infra* p. 307). In the light of the above observations, McClelland's remarks regarding *O. maculatus* that "it is an intermediate form between *Schizothorax* and *Oreinus*" is readily understood. According to McClelland, *O. maculatus* "seldom exceeds six inches in length" and is, therefore, a young form. There are several young specimens of *O. griffithii* in Dr. Chopra's collection which agree with *O. maculatus*, both in general

features and colouration. I have no doubt, therefore, that *O. maculatus* is a synonym of *O. sinuatus* and that both Günther and Day were justified in this conclusion.

The Kabul River form, *O. sinuatus* var. *griffithii*, may be redescribed as follows :—

D. 3/8 ; A. 3/5 ; P. 21 ; V 10 ; C. 20.

Oreinus sinuatus var. *griffithii* is a strong and muscular fish in which the body is subcylindrical and both the profiles are somewhat arched. The ventral surface of the head and the anterior part of the body are flattish. The head is short and bluntly pointed ; its length is contained 4.1—5.0 times in the total length without the caudal. In the young specimens, the head is proportionately larger, but during growth the other parts of the body develop more vigorously so that in larger examples it is about one-fifth of the length without the caudal. The head is almost as broad as deep at the occiput ; the width of the head is equal to its length behind the anterior nostrils. The snout is usually smooth but in a number of half-grown and adult specimens it is covered with warts. These structures seem to characterize male specimens. The eyes are, for the most part, in the anterior half of the head ; they are lateral in position but their upper margin is slightly below the dorsal profile of the head and they are not visible from the ventral surface. The eyes are proportionately larger in young specimens ; their diameter is contained 4.1—6.7 times in the length of the head ; 1.3—2.5 times in the length of the snout and 1.3—2 times in the interorbital width. The interorbital space is broad and flat. The mouth is inferior, transverse and slightly arched ; the width of the mouth is somewhat greater than half the width of the head. The lips are fleshy and continuous ; the upper lip covers the jaw and is simple, the lower lip is reflected from the jaw and is papillated. The exposed portion of the lower jaw is sharp and enclosed in a thick horny sheath. There are two pairs of small barbels. The gill-openings are moderate and extend to the ventral surface for a considerable distance.

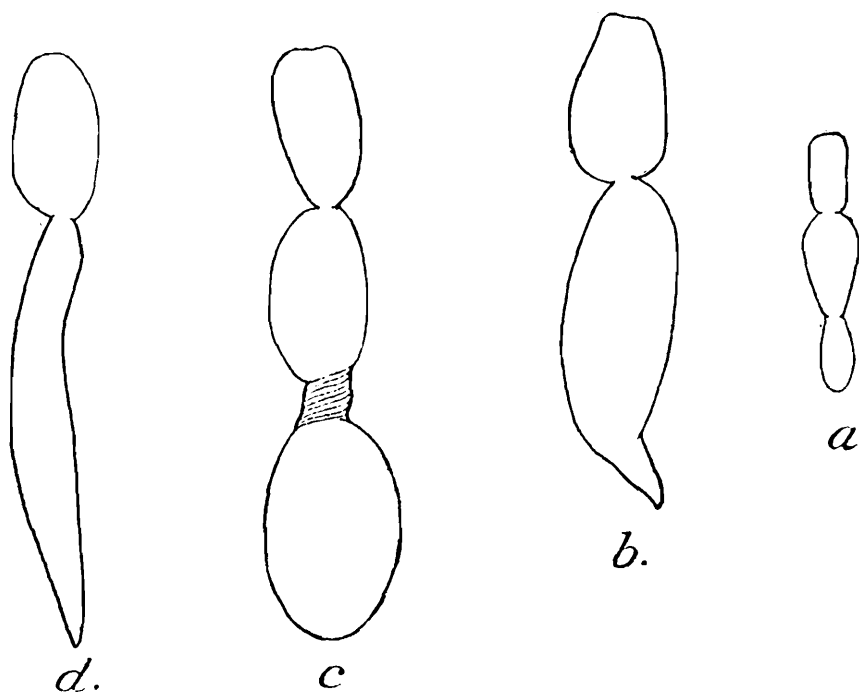
The depth of the body is contained 4.7—5.3 times in the length without the caudal ; it is covered with small scales, about 110 along the lateral line and 28 between it and the base of the dorsal spine. The lepidosis is irregular. The tiled row of anal scales is indistinct, the largest scale being much less than half the diameter of the eye. The lateral line is slightly curved but it runs to the middle of the base of the caudal fin.

The dorsal fin commences in advance of the ventral and is nearer to the tip of the snout than to the base of the caudal fin ; the dorsal spine is long and strong and is serrated with moderate spines posteriorly ; it is not as long as the head and possesses a thin, flexible portion which is equal to the diameter of the eye. The posterior margin of the dorsal fin is slightly emarginate. The paired fins are horizontally placed and their outer rays are the longest. The pectoral fin is shorter than the head and is separated from the ventral by a considerable distance.

The ventral fin is considerably removed from the anal. The anal opening is situated just in front of the anal fin, which, when laid flat, is separated from the caudal fin by a considerable distance. The caudal fin is deeply emarginate; the lower lobe is better developed than the upper. The caudal peduncle is strong and muscular; its least height is contained 1.6—1.9 times in its length.

In young specimens the upper part of the body is marked with short, black streaks characteristic of *Oreinus maculatus*. The ground colour is grayish above and pale white below. In half-grown and adult specimens, the black markings disappear and the fish takes on a silvery hue. On this account it is usually known as "snow-trout"

Air-bladder.—When dissecting specimens to examine the stomach contents, I found a great range of variation in the structure and form of the air-bladder in *O. sinuatus* var. *griffithii*. As the air-bladder is a character of great diagnostic value in the taxonomy of Cyprinoid fishes, it is necessary to make a few observations on the condition of the organ in the specimens before me.



TEXT-FIG. 5.—Air-bladders of 4 specimens of *Oreinus sinuatus* var. *griffithii* McClelland showing variation in form and structure. $\times \frac{2}{3}$. The thickness of the lines roughly indicates the thickness of the walls of the different chambers.

- Three-chambered bladder of a young specimen 110 mm. long.
- Air-bladder of a specimen 225 mm. long showing modification of the posterior chamber at the hinder end.
- Three-chambered bladder of a specimen 265 mm. long. Notice the broad collar separating second and third chambers.
- Normal type of air-bladder in an adult specimen. Notice the posterior chamber is narrow, elongated and thick walled and has not the form and structure of the normal bladder of the Cyprinoid fishes.

In a young specimen about 110 mm. long, the air-bladder is almost tripartite; the anteriormost chamber possesses somewhat thick walls,

the middle chamber is moderately thick-walled while the small, third chamber is thin-walled. The pneumatic duct opens between chambers one and two. At the constriction between the middle and the last chamber, the skin is specially thick. This tripartite condition is better marked in the bladder of another specimen (fig. 5 c.) about 265 mm. in length. Here instead of a constriction between chambers two and three, there is a definite collar of very thick skin while the last chamber is very thin walled. Normally in these fishes the air-bladder is bipartite, as is characteristic of the Cyprinidae. Owing to life in rapid waters and in consequence of a ground habit, the air-bladder is not much used as a hydrostatic organ and its walls become thick and inelastic (fig. 5a). The lumen decreases and the bladder becomes greatly reduced in size. It has been shown in the case of other genera¹ that the reduction and solidification of the bladder starts with the posterior chamber. In *griffithii* also probably the same process takes place. In a specimen 225 mm. in length, the end portion of the posterior chamber of the bladder was found to be thin and pointed and had very thick walls (fig. 5 b). Evidently the solidification of posterior chamber had started in this specimen at the right place and in course of time the bladder would have assumed the normal form as shown in figure 5d. The tripartite condition of the bladder in this species is certainly abnormal and, in my opinion, is produced by the thickening of the skin of the middle part of the posterior chamber instead of its hindermost part. In any case such a condition is not of any great importance for taxonomic purposes. I have shown elsewhere² that the bladder of hill-stream fishes is greatly reduced as they invade swifter and swifter currents and that if they happen to revert to deeper waters, a structure similar to the original bladder makes its appearance for hydrostatic purposes. Thus there is a close correlation between the structure of the bladder and the habitat of the fish. In fishes that live in rapid, but relatively deeper waters, the structure of the bladder must be very variable as has been shown above in the case of *Oreinus*.

Tchang,³ in establishing his genus *Parosteobrama* has observed that "vessie natatoire en 3 parties, la' premiere, ovale et arrondie aux deux bouts, la deuxieme plus longue que la premiere, la troisieme tres petite" Unfortunately no figure is published but the description indicates a structure similar to the one figured here as 5b. It is probable that the so-called third chamber of *Parosteobrama* represents the area where the bladder has started to acquire thick walls. It should also be borne in mind that *Rohtee* (= *Parosteobrama*) is a genus of clear-water streams and though it is not found in very swift currents, it is always subject to sudden rush of waters. Such a habitat also denotes a varying environment. Mukerji⁴ has shown that normally there are only two chambers in *Rohtee*. In *R. pelligrini* the third chamber may be only a modified portion of the second as stated above.

¹ Hora, *Journ. As. Soc. Bengal* (N. S.) XVIII, pp. 5-7 (1922).

² Hora, *Journ. Bombay Nat. Hist. Soc.* XXXIV, pp. 374-385 (1930).

³ Tchang, *Bull. Soc. Zool. France* LV, pp. 46-52 (1930).

⁴ Mukerji, *Journ. Bombay Nat. Hist. Soc.* XXXVII, p. 69 (1934).

Distribution and Habitat.—*Oreinus sinuatus* var. *griffithii* has so far been recorded from the Kabul River and its tributary streams. It was originally described from the Kunar or Chitral River. The species is well represented in the Chitral Valley whence Dr. Chopra collected specimens from the following localities :—

- (i) 38 specimens from the Pallarga stream, 2 miles below Kunisht in the Rambhur Valley (Sta. 2).
- (ii) 21 specimens from the Bumboret River between Daimali and Karakal in the Bumboret Valley (Sta. 7).
- (iii) 86 specimens from the Lutkuh River near Uts or Hot Springs (Sta. 9).
- (iv) 14 specimens from the Mastuj River between Koghazi and Mastuj (Sta. 12).
- (v) 22 young specimens from a small stream near Surguz (Sta. 13).
- (vi) 11 specimens from a small stream between Tar and Drosh (Sta. 15).
- (vii) 12 specimens from Ramram gol near its junction with the Chitral River below Arandu (Sta. 16).
- (viii) 28 specimens collected at Chitral in August 1929.

The larger specimens were obtained from rivers with rocky beds and fast currents, while the young ones were collected from small streams generally containing vegetation or with a sandy bed. It seems probable that the small streams form the nurseries where larger fish resort to for breeding purposes. Most of the young specimens appear to be intermediate between *Schizothorax* and *Oreinus*, and it seems likely that some of them are hybrids. I have discussed the affinities of such specimens below. According to Dr. Chopra's observations the species lives under stones and rocks.

Bionomics.—The alimentary canal of *O. griffithii* is greatly convoluted and is about 2.6 times the total length of the fish. As has already been observed by Griffith, it contains a brownish pulp, but in one case both the stomach and the intestine were full of sand and gravel. The structure of the lips and jaws shows that the fish adheres to smooth rocks and scrapes off algal matter which, no doubt, forms its principal food. Its horizontal paired fins, flattish ventral surface and the papillated lower lip are modified for the purpose of adhesion; whereas its sub-cylindrical body is adapted to offer the least resistance to rushing currents. During floods in the Bumboret River, a few specimens of *griffithii* were washed ashore; but the mortality among this species was not so high as in *Glyptosternum reticulatum*. *Oreinus* is a powerful swimmer and can dart from rock to rock with great rapidity. It prefers to live among rocks on the sloping side of a rapid over which water rushes with great speed.

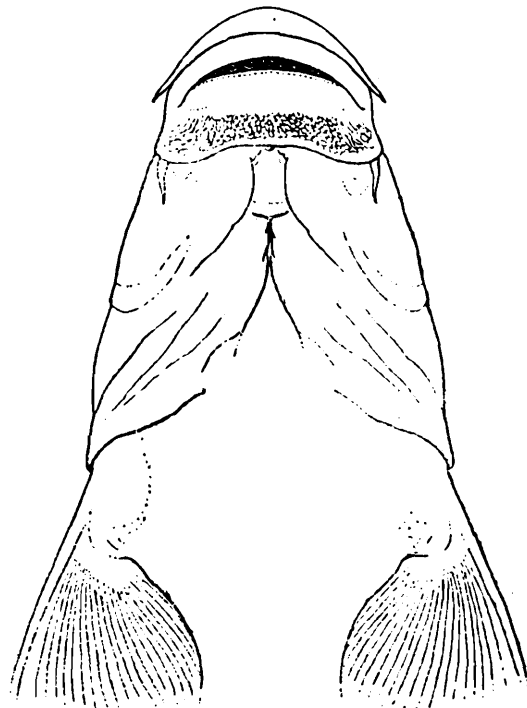
Local Name.—According to Dr. Chopra, *O. sinuatus* var. *griffithii* is known as *Omatchhi* among the Kafirs.

Measurements in millimetres.

	Specimens with en- larged anal scales.		Sta. 2.		Sta. 12.		Sta. 9.	
	Sta. 2.	Sta. 12						
Total length excluding caudal	325.0	260.0	168.0	102.0	122.0	103.0	265.0	255.0
Length of head	64.0	52.0	38.0	22.0	27.0	25.0	52.0	52.0
Width of head .	43.0	33.0	24.0	14.5	17.0	14.0	36.0	35.0
Height of head	43.0	33.0	24.0	14.5	19.0	16.5	34.0	34.0
Diameter of eye.	10.0	8.0	7.0	4.5	6.0	6.0	9.0	9.0
Length of snout	25.0	18.0	14.0	9.0	9.0	8.0	20.0	17.0
Interorbital width	20.0	16.0	10.0	6.0	9.0	8.0	16.0	15.0
Depth of body	66.0	49.0	33.0	20.0	25.0	22.0	55.0	53.0
Length of dorsal spine	45.0	41.0	29.0	18.0	22.0	22.0	42.0	38.0
Longest ray of anal	60.0	39.0	27.0	15.0	21.0	19.0	43.0	38.0
Length of pectoral	64.0	43.0	32.0	19.0	21.0	20.0	45.0	43.0
Distance between pectoral and base of ventral.	35.0	30.0	12.0	9.5	10.0	8.0	25.0	26.0
Length of ventral	58.0	40.0	28.0	17.0	20.0	19.0	41.0	39.0
Distance between ventral and anal	30.0	24.0	9.0	6.0	6.0	6.0	16.0	18.0
Length of caudal peduncle	60.0	42.0	22.0	13.0	16.0	14.0	46.0	42.0
Least height of caudal peduncle	35.0	30.0	17.0	10.0	13.0	10.0	32.0	30.0

? *Schizothorax labiatus* × *Oreinus sinuatus* var. *griffithii*.

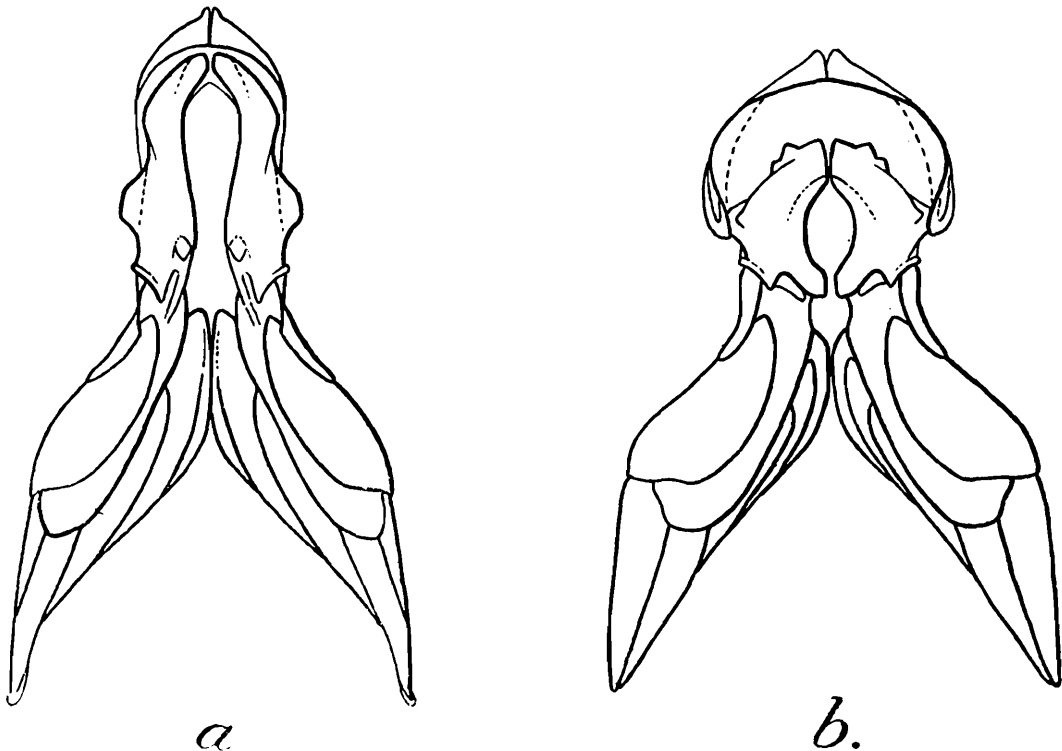
References have already been made (*vide supra*, pp. 294, 302) to the fact that in Dr. Chopra's collection there are several young and half-grown specimens in which the structure of the lips and jaws is interme-



TEXT-FIG. 6.—Ventral surface of head and anterior part of body of *Oreinus sinuatus* var. *griffithii* McClelland showing the nature of lips and jaws.

diate between *Schizothorax* and *Oreinus*. In fact, all possible gradations exist between the *Schizothorax* and the *Oreinus* types of mouth,

I have also no doubt that *Oreinus* is a more specialised form of *Schizothorax* and that it is better adapted to live in swifter currents. The modifications of the lips and jaws are clearly indicative of such a specialisation. The two genera are very closely related, the main difference being that in *Oreinus* the broad, short and flat mandibles are loosely joined together. The anterior margin of the lower jaw is exposed and is covered with a thick horny sheath. The lower lip forms a papillated, broad band behind the naked portion of the jaw and is probably used for adhesion. In conformity with the bony structures mentioned above the head is short, flat and depressed in *Oreinus*, while it is elongated and narrow in *Schizothorax*.



TEXT-FIG. 7.—Skeleton of the lower jaw and associated structures of *Schizothorax* and *Oreinus* in ventral view. $\times 1\frac{1}{2}$.

a. *Schizothorax labiatus* (McClelland).

b. *Oreinus sinuatus* var. *griffithii* McClelland.

A few selected stages between the *Schizothorax* and the *Oreinus* types of mouth-parts may be described here.

(a) Total length 148 mm. Length of head 34 mm.

The central lobe of the lower lip is much narrower otherwise it is similar to that of *Schizothorax labiatus*.

(b) Total length 131 mm. Length of head 31 mm.

The structure of the lips and the associated parts is not very different from that of the typical examples of *Schizothorax labiatus*.

(c) Total length 141 mm. Length of head 31 mm.

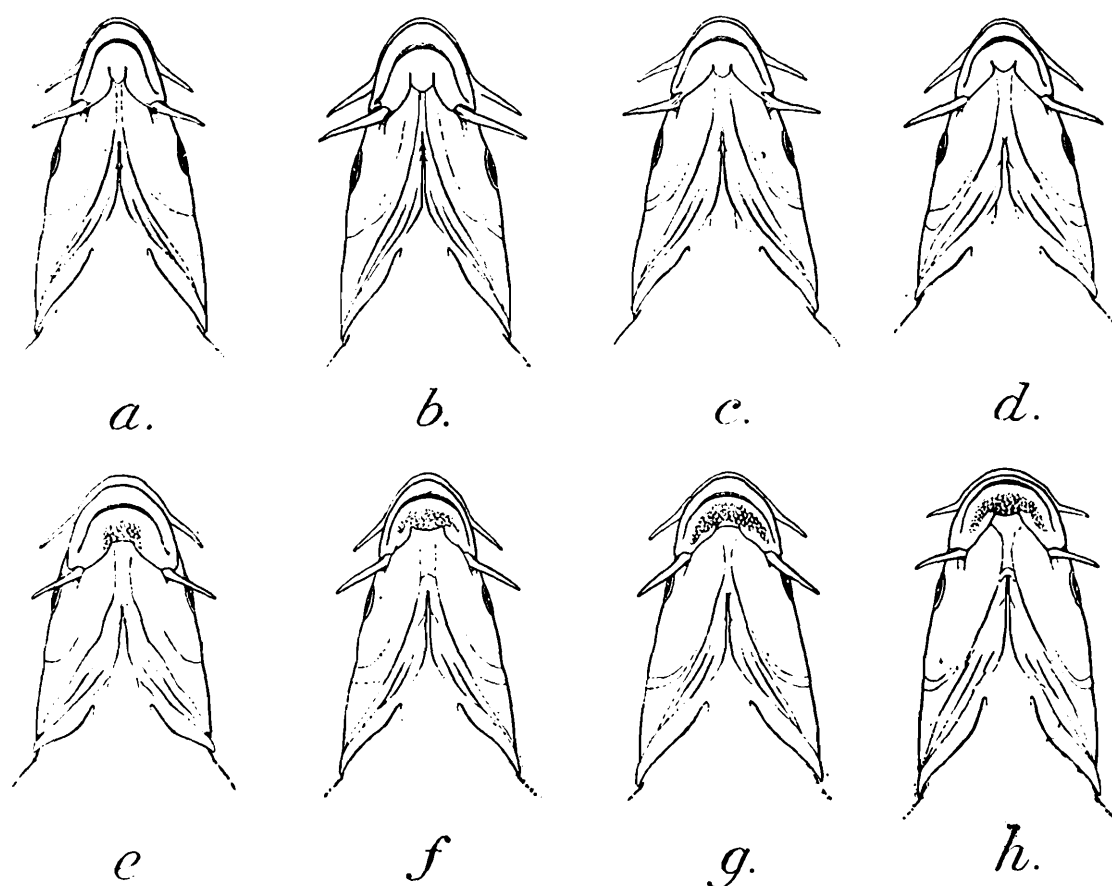
The mandible has become somewhat shorter and broader and the central lobe of the posterior lip is slightly reduced.

(d) Total length 153 mm. Length of head 34 mm,

The posterior lip is still further modified and the snout is considerably broad.

(e) Total length 137 mm. Length of head 30 mm.

The head has assumed the *Oreinus* form though the structure of the lips and jaws is not of the *Oreinus* type yet. The central lobe of the posterior lip has disappeared and its middle part has become papillated. The barbels are somewhat shorter.



TEXT-FIG. 8.—Ventral surface of head in eight specimens intermediate between *Schizothorax* and *Oreinus* in regard to the nature of the lips and jaws and the form of the head. All figures are more or less of natural size.

a-d represent retrogressive modifications in the *Schizothorax labiatus* type of mouth-parts, while e-h represent progressive modifications towards the formation of an *Oreinus* type of mouth-parts.

(f) Total length 128 mm. Length of head 30 mm.

The head is more or less of the *Schizothorax* type but the lips are considerably modified. The posterior lip is papillated.

(g) Total length 145 mm. Length of head 34 mm.

The head is not so broad as in *Oreinus* but the extent of papillae on the lower lip is considerably greater.

(h) Total length 141 mm. Length of head 32 mm.

The head is of the *Oreinus* type and the posterior lip is papillated. The most remarkable feature of this specimen is that the mouth is situated only slightly behind the tip of the snout.

It is clear from the measurements given above that the various modifications are not correlated with size.

When determining the collection from Chitral these intermediate forms proved very troublesome, for it was noticed that in the normal young of *Oreinus* the characters of the genus were present in earlier stages of development and they could readily be referred to *O. sinuatus* var. *griffithii*. Similarly the lip character of *Schizothorax labiatus* is also marked at an early stage. After a great deal of consideration I can suggest two possibilities for the occurrence of these intermediate forms. They are either the young of *Oreinus* which have not shaken off the ancestral characters of *Schizothorax* or they represent hybrids between the two common 'Barkels' of the Chitral Valley. The latter supposition seems to be more justified, for intermediate forms occur in great abundance. Even Griffith and McClelland noticed their presence in Afghanistan. Hybridisation among fishes in nature is not a rare occurrence, and several instances have been figured and described by Berg from Central Asia. Both *Oreinus* and *Schizothorax* live in large, rapid-water rivers and prefer a more or less similar habitat—the rocks of the rapids in the course of streams. If the breeding period of the two Chitral species were to coincide at any place, there is a likelihood of the production of a large number of hybrids. The examination of the gonads of the two species shows that they both breed in the summer months and it is not unlikely, therefore, that the intermediate forms in Dr. Chopra's collection represent hybrids between *Schizothorax labiatus* and *Oreinus sinuatus* var. *griffithii*.

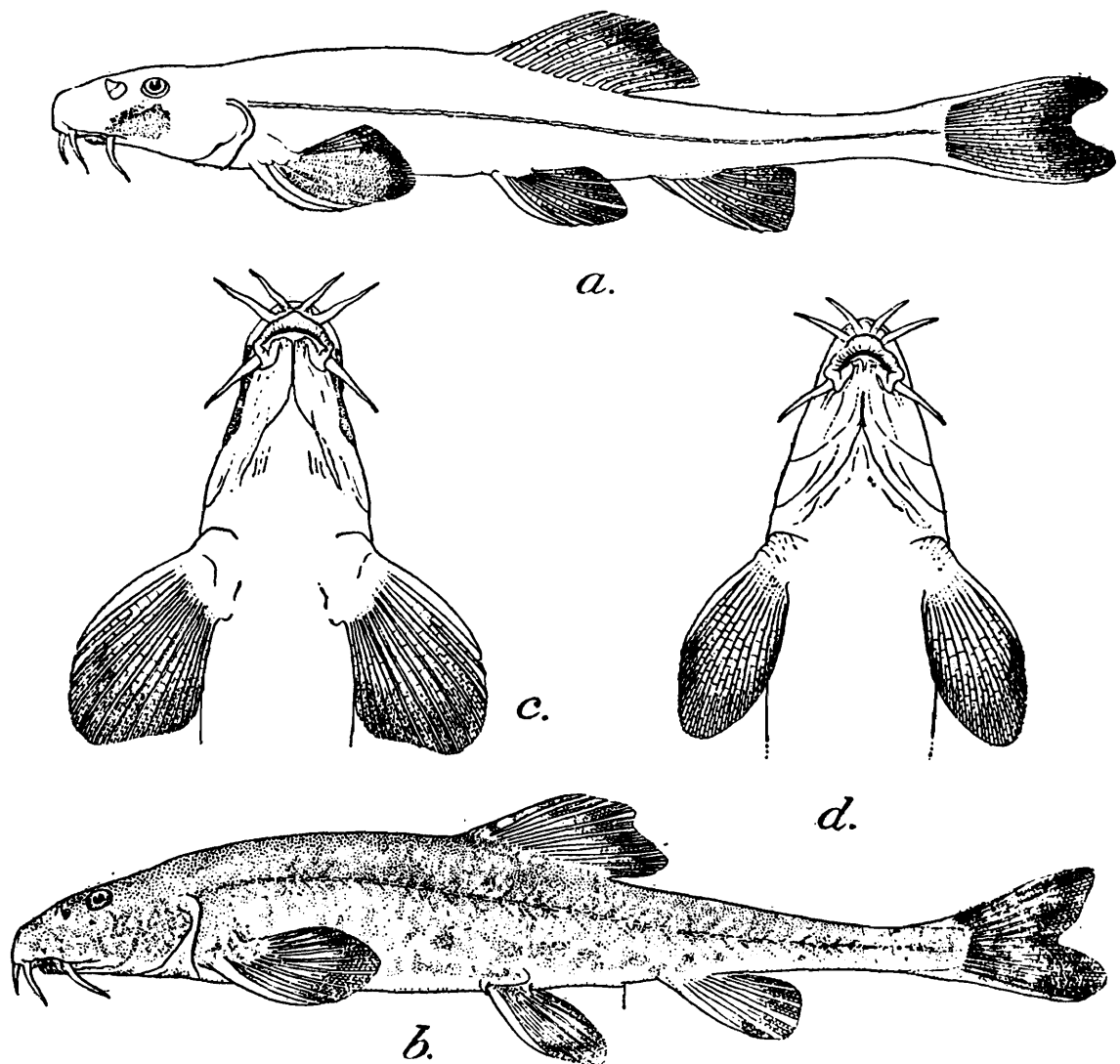
***Nemachilus choprai*, sp. nov.**

D. 3/8 ; A. 2/5 ; P. 11-12 ; V. 8.

Nemachilus choprai is a large and stoutly built species in which the body tapers towards both ends, but very markedly towards the tail. The dorsal profile is gently arched, but the ventral surface is flat and horizontal and the ventral profile is almost straight up to the anal-opening. The caudal peduncle is long and narrow and whip-like. The body is naked, smooth and glossy. The paired fins are horizontally placed.

The head is depressed and flattened on the ventral surface ; it is evenly pointed in the female specimens whereas in the males the snout is broader and the extremity is much more rounded. The length of the head is contained 4.7—5.1 times in the total length without the caudal and 5.6—5.9 times in the length with the caudal. The width of the head is contained 1.4—1.6 times and its height at the occiput 1.6—1.9 times in its length. The depth of the body varies considerably with the sex of the individuals ; in some ripe females it is contained 5 times in the length without the caudal. Usually the depth is contained 5.9—9 times in the length with the caudal and 5—7.6 times in the length without the caudal. The eye is situated either entirely or for a greater part of its length in the posterior half of the head ; it is placed dorso-laterally and is not visible from the ventral surface. The diameter of the eye is contained 6.1—7.4 times in the length of the head, 2.9—3.5 times in the length of the snout and 1.5 to 2 times in the interorbital distance. The nostrils are situated nearer to the eyes than to the tip of the snout ; there is a well marked flap between the

two nostrils on each side. There are six well-developed barbels, 4 rostral and two maxillary; all are much longer than the diameter of the eye. The small, lunate mouth is situated on the ventral surface considerably behind the tip of the snout; it is bordered by prominent fleshy lips which are continuous at the angles of the mouth. The lower lip is interrupted in the middle where the lower jaw is left uncovered. When the mouth is closed, the upper jaw, which is sharp and vertical, lies in front of the lower jaw. The lateral line is complete and well marked throughout its length. The caudal peduncle is long and narrow; its least height is contained 4.5—5.2 times in its length in the females and 5—5.9 times in the males.



TEXT-FIG. 9.—*Nemachilus choprai*, sp. nov.

- a. Outline drawing of the lateral view of a male specimen showing secondary sexual characters. $\times \frac{2}{5}$.
 b. Lateral view of a female specimen. $\times \frac{2}{5}$.
 c. Ventral surface of head and anterior part of body of a male specimen. $\times 1$.
 d. Ventral surface of head and anterior part of body of a female specimen. $\times 1$.

The difference in the general facies and in the form of the head in the two sexes is very marked.

The dorsal fin begins in advance of the ventrals and its commencement is almost midway between the tip of the snout and the base of the caudal; in some individuals it is somewhat nearer to the former than to

the latter. The longest ray of the dorsal is shorter than the depth of the body in ripe females ; whereas it is invariably longer in the males. The upper margin of the fin is notched and its anterior upper corner is rounded. The pectoral fin is shorter than the head and is provided with a muscular base ; it is rounded, horizontally placed and provided with a number of broad, bony rays anteriorly. The pectoral fin extends for about three-fifths of the distance between the bases of the pectoral and ventral fins. The ventral fin is situated on the ventral surface and is similar to the pectoral fin though considerably shorter ; it just reaches or extends beyond the anal opening, which is followed by a deep groove. The males are provided with a well-marked papilla in this groove and in them the ventrals almost reach the base of the anal fin. There is a fleshy appendage at the base of the ventral which is adnate to the body throughout its length. The anal fin is short and its posterior margin is rounded ; it is separated from the caudal fin by a considerable distance. The caudal fin is shorter than the head and is deeply emarginate with the lobes rounded. In some examples the upper lobe is slightly longer than the lower.

The colouration of this species seems to be fairly constant. The ground colour is pale-olivaceous with the ventral surface possessing a uniform lighter colour. The dorsal surface and the sides are clouded with a number of black patches which are more numerous and of a deeper colour above the lateral line. The ground colour appears in minute spots here and there. On the dorsal surface in the tail region there is a series of four to five broad, but short, bands of the ground colour. There are sometimes horizontal, narrow streaks of lighter colour in front of the dorsal fin. The pectoral, ventral and anal fins are without any markings. The caudal fin is irregularly marked with a number of bands, while there are indications of similar bands on the dorsal fin. The anterior margin of the undivided rays of the dorsal fin is conspicuously marked with about 5 dark spots. This last feature is characteristic of the species.

In young specimens, up to about 100 mm. in total length, the general colouration is relatively lighter and there is usually a series of rounded spots all along the lateral line.

Type-specimen :—F 11301/1, *Zoological Survey of India (Ind. Mus)*.

Distribution and Habitat :—*Nemachilus choprai* is the only loach known from the Chitral Valley whence Dr. B. N. Chopra obtained as many as 131 specimens. They were collected in the following localities :—

- (i) Forty-seven specimens from the Lutkuh River near Hot Springs (Sta. 9). (*Type-locality*).
- (ii) Thirty-two specimens from the Mastuj River between Koghazi and Mastuj (Sta. 12).
- (iii) Three specimens from a small stream above Charun in the Mastuj Valley (Sta. 14).
- (iv) Forty-nine specimens from the Chitral River near the Chitral town.

Nemachilus choprai lives in large rivers with a swift current. The bed of such streams consists of stones and boulders with patches of sand and mud here and there. The water is usually clear but becomes muddy after freshets. Dr. Chopra did not observe any vegetation growing

in the large streams, but in the small stream above Charun there was plenty of vegetation and the bottom consisted of mud and sand with a few stones. The three relatively young specimens in the collection were obtained from this small stream, and it seems probable that the mature specimens migrate to smaller streams with plenty of vegetation for spawning purposes. In such situations the young not only get protection in vegetation, but they find a number of small organisms to feed on.

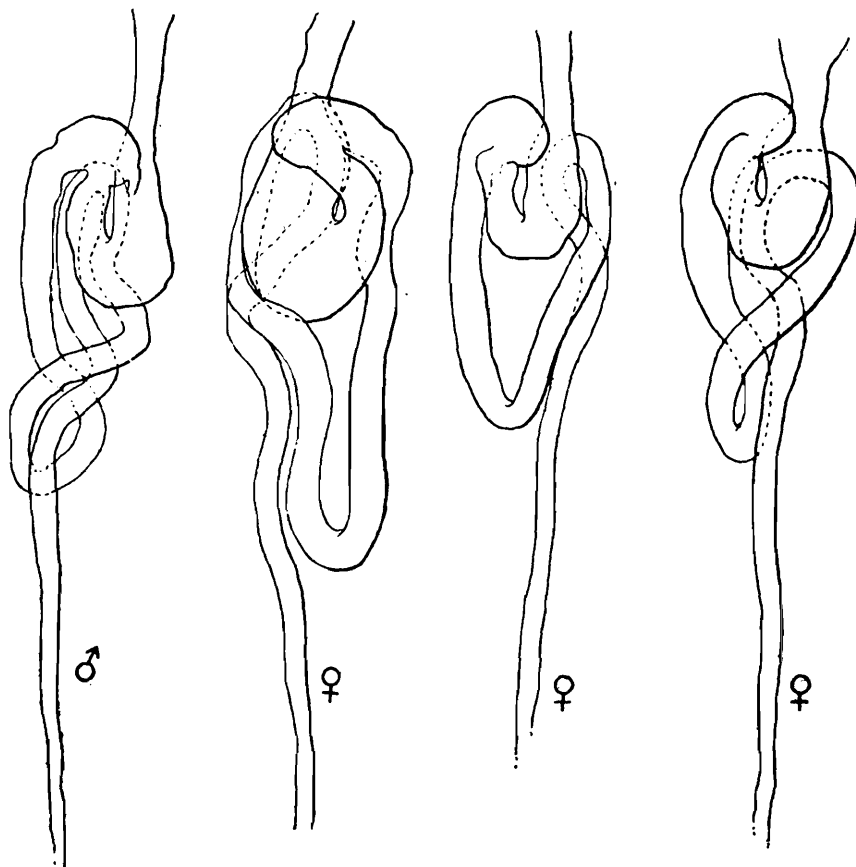
Sexual Dimorphism and the Proportion of Sexes :—*Nemachilus choprai* exhibits well-marked secondary sexual characters and the two sexes can be separated even in specimens about 100 mm. in total length though the species grows to about twice this size. The males are provided with the usual secondary sexual characters which consist of a raised tuberculate area below the nares, separated ventrally by a groove from the adjacent parts of the skin, of a second tuberculate area behind and below the first one and of broad pectoral rays which are provided with thickened tuberculate pads on their dorsal surface. Besides these obvious differences the males possess a broader and more rounded snout, a longer and narrower caudal peduncle and a papilla in the groove behind the anal opening. The males are usually of a larger size and in them the ventrals almost reach the anal fin.

Of the 131 specimens of *Nemachilus choprai*, there are 30 females and 101 males, or a proportion of 22·9 per cent. females and 77·1 per cent. males. If these calculations indicate an actual proportion of sexes in the population, the fact is remarkable. The preponderance of the males in the collection may be due to the fact that they are of much stronger build and are possibly of very active habits; whereas the females may be of secretive habits and thus liable to escape the notice of collectors. This alone, however, does not seem sufficient to account for the great difference in the percentage of the two sexes.

Bionomics.—*Nemachilus choprai* is a bottom dwelling fish. Its flattened ventral surface and broad, rounded and horizontal paired fins are no doubt used for grappling on to the smooth surfaces of rocks. The greatly reduced air-bladder also indicates that the fish lives mostly at the bottom, where it either crawls with the help of its paired fins, or darts from rock to rock with the help of its muscular tail and the whip-like caudal peduncle. Its long and narrow streamline form is adapted both for rapid movements as also for offering less resistance to swift-flowing currents. At the bottom the fish feeds on algae and slime that grow on rocks. Several kinds of Dipterous, Trichopterous and Ephemeropterous larvae that live on bare stones or among algae also form a substantial part of the food of this species. Large Coleopterous larvae that usually live among pebbles at the bottom were also found in the stomach of *N. choprai*. The nature of food indicates a ground habit of life. The entire intestine is usually full of sand and gravel, most of which is probably derived from the cases of Trichopterous larvae and pupae.

The food is scraped from the rocks with the sharp and shovel-like posterior jaw while the anterior jaw, which lies in front of it and forms a vertical plate, helps to prevent the escape of the heterogeneous scraped matter. The position, in which the coils of the alimentary canal lie,

varies considerably as shown in the accompanying figure. It appears that females feed most voraciously when the gonads begin to develop, but in specimens with fully developed ovaries the stomach is either empty or contains very little food. In such cases the liver is also greatly reduced. It seems probable, therefore, that about the spawning time the females give up feeding altogether. The ovaries fill up the body cavity to such an extent that feeding seems almost a physical impossibility. Most of the individuals opened had only insect larvae in their stomachs.



TEXT-FIG. 10.—Alimentary canal of *Nemachilus choprai*, sp. nov. $\times 1\frac{1}{2}$.

The four drawings illustrate the variable nature of the coils of the alimentary canal.

Remarks.—*Nemachilus choprai* belongs to the Central Asiatic group of species in which the caudal peduncle is long and narrow. It is closely allied to *N. tenuis* Day and *N. kashmirensis* Hora. The former possesses a narrower head and longer barbels; while in the latter the caudal peduncle is 3—3.9 times its least height and the eyes are situated almost in the middle of the length of the head. The colouration of *N. choprai* is different from either.

Until quite recently very little was known regarding the Nemachili that inhabit the waters of Afghanistan. Griffith¹ had observed that a loach was very common in the small channels by which the springs at Sir-i-Chashma run off and through the kindness of Major A. E. Farwell

¹ McClelland, *Calcutta Journ. Nat. Hist.* II p. 564 (1842).

Measurements in millimetres.

	♀	♀	♀	♀	♀	♀	♀ (fig.)	♂	♂	♂ (fig.)	♂	♂
Total length including caudal	133.5	134.5	141.5	144.0	150.5	162.0	162.0	150.0	156.0	161.6	163.0	172.0
Length of caudal	20.0	21.0	21.0	21.0	22.0	22.0	25.5	25.0	22.0	23.8	25.0	27.7
Length of head	23.0	24.0	23.7	25.2	25.4	28.3	28.0	26.2	27.5	29.0	29.0	30.0
Width of head	15.7	16.3	16.5	16.7	16.3	20.0	19.2	17.2	17.4	19.0	20.0	18.0
Height of head	13.2	13.2	13.2	14.3	14.0	15.3	16.0	16.0	15.8	14.8	16.0	15.7
Depth of body	17.8	19.0	24.0	16.0	21.2	25.3	25.0	17.5	21.0	19.0	20.2	21.0
Length of snout	11.0	11.2	12.2	11.6	12.2	13.5	14.0	12.5	14.0	14.2	15.0	14.7
Diameter of eye	3.5	3.7	3.4	3.7	3.6	4.1	4.4	4.3	4.5	3.9	4.2	4.6
Interorbital width.	5.6	5.8	6.0	6.5	7.0	7.5	8.0	7.0	7.2	7.8	6.3	8.0
Length of caudal peduncle	29.2	31.0	29.3	30.0	31.0	36.0	34.5	32.0	35.8	37.0	35.0	38.0
Least height of caudal peduncle	5.6	6.0	6.5	6.5	6.5	7.0	7.0	6.0	6.6	6.2	7.0	7.5
Longest ray of dorsal	18.7	17.5	18.2	18.6	20.1	21.8	21.0	18.5	21.0	20.6	22.0	26.0
Longest ray of anal	15.5	15.0	16.0	18.5	17.0	20.6	18.0	19.0	18.8	20.2	20.0	23.0
Length of pectoral	20.6	20.5	22.0	24.0	21.2	26.6	24.5	25.0	24.2	27.0	26.0	29.0
Length of ventral	18.0	17.0	19.6	20.0	19.5	21.0	21.5	20.5	20.7	22.0	21.0	24.2

four young specimens were obtained last year from this locality.¹ Similar specimens have also been collected from the Paghman River² and the Chahiltran stream, both tributaries of the Kabul River. This Kabul River form has been described by me as *Nemachilus griffithii* var. *afghana*. In this variety the caudal peduncle is not so long and whip-like as in *N. choprai*; the least height of the caudal peduncle being contained 2—2.2 times in its length. Besides these two forms, no other loach has so far been described from the upper reaches of the Kabul River and its tributary streams.

I (*op. cit.*, 1934) have recently remarked on the other species known from Afghanistan and it may be noted that *N. choprai* is abundantly distinct from all these forms. *Adiposia boutanensis* possesses an adipose dorsal and has a very characteristic facies, while *Nemachilus griffithii*, though very close to *N. choprai*, differs slightly in the length of the barbels, the position of the eye, the length of the pectoral, the colouration, etc., and has a different type of caudal peduncle. In the types of *N. griffithii* the least depth is contained 2.6—3 times in the length, whereas in *N. choprai* the figures are 4.5—5.9. When comparing the two forms, this character strikes one directly.

The measurements of a dozen specimens (7 ♀♀ and 5 ♂♂) collected in the Lutkuh River near Hot Springs are given on the opposite page.

***Nemachilus kashmirensis* Hora.**

1876. *Nemacheilus rupicola*, Day (*nec* McClelland), *Proc. Zool. Soc. London*, p. 799.
 1878. *Nemacheilus rupicola*, Day (*nec* McClelland), *Sci. Res. 2nd Yarkand Mission Ichthyology*, p. 17.
 1922. *Nemachilus kashmirensis*, Hora, *Rec. Ind. Mus.* XXIV, p. 76.

In 1922, it was shown that Day had confused his Kashmir specimens of *Nemachilus* and had wrongly referred them to *N. rupicola* (McClelland), a species widely distributed in the Simla Hills. The name *kashmirensis* was proposed for this form and several specimens collected in the Verinag and Kukarnag Springs and in a small stream at Harwan were assigned to it. At the time I did not give a full description of the species and subsequently, owing to pressure of other work, it has not been possible to prepare a monograph on the Indian species of the genus in which I hoped to publish the description of the new species. *N. kashmirensis* is closely allied to the species described above and as Kashmir and Chitral are adjacent countries I have thought it advisable to publish the account of the Kashmir form here.

D. 3/8; A. 2/5; P. 12; V 8.

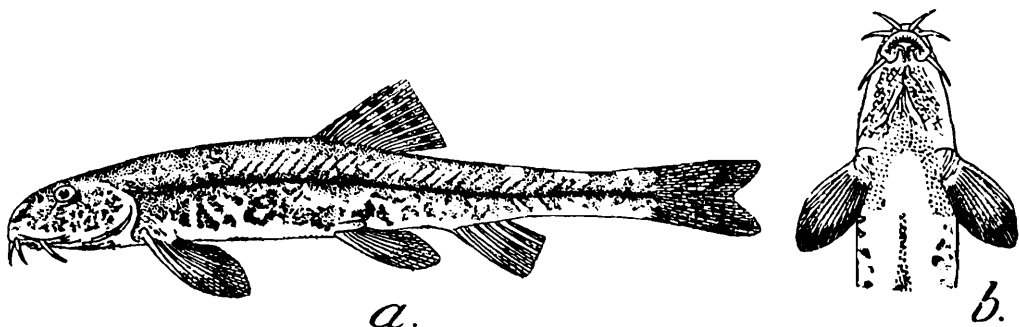
In *Nemachilus kashmirensis* the body tapers towards both ends and the dorsal profile is gracefully arched. The ventral surface is broad and flattened, and the ventral profile is straight and horizontal except in the region of the caudal peduncle. The fish is strongly built and

¹ Hora, *Journ. Bombay Nat. Hist. Soc.* XXXVII, (in press).

² Hora, *Journ. Bombay Nat. Soc.* XXXVI, pp. 697-699, pl. figs. 1 and 2 (1933).

possesses a whip-like, long and narrow caudal peduncle. The body is smooth and glossy and devoid of scales. The head is evenly pointed, but somewhat rounded towards the extremity.

The head is proportionately much longer in the young specimens ; its length is contained 4—4.7 times in the total length without the caudal and 4.7—5.8 times in the length with the caudal. The width of the head is contained 1.3—1.5 times and its height at the occiput 1.6—1.8 times in its length. The depth of the body varies with age as well as with sex ; it is contained 5.7—7.2 times in the total length without the caudal and 7—8.8 times in the length with the caudal. The eye is situated dorso-laterally in the middle of the head and is not visible from the ventral surface ; its diameter is contained 5—6.5 times in the length of the head, 2—2.6 times in the length of the snout and 1.3—1.8 times in the interorbital width. The nostrils are situated nearer to the eye than to the tip of the snout. There are six barbels, two maxillary and four rostral ; they are well marked and are longer than the diameter of the eye. The mouth is on the ventral surface behind the tip of the snout ; it is bordered by well-developed lips, which are continuous at the angles of the mouth and are fimbriated. The lower lip is interrupted in the middle and each portion is reflected backwards. The ventral surface of the head is rugose and papillated. The lateral line is complete and well marked throughout its length. The caudal peduncle is long and narrow ; its least height is contained 3—3.9 times in its length.



TEXT-FIG. 11.—*Nemachilus kashmirensis* Hora.

a. Lateral view. $\times \frac{3}{4}$.

b. Ventral surface of head and anterior part of body. $\times \frac{3}{4}$.

The dorsal fin is situated in advance of the ventrals and its commencement is equidistant between the tip of the snout and the base of the caudal fin ; its longest ray is greater than the depth of the body below it and its upper margin is oblique and truncate. The pectoral fin is somewhat shorter than the head and is rounded posteriorly ; it is horizontally placed and possesses a strong muscular base ; it extends almost two-thirds of the distance to the base of the ventral fins. The ventral fin is situated on the ventral surface and is similar to the pectoral fin ; it extends considerably beyond the anal opening and is provided with a fleshy appendage at its base. The appendage is adnate to the body throughout its length. The anal fin is short and is similar to the dorsal ; it is separated from the base of the caudal fin by a considerable distance. The caudal fin is somewhat shorter than the head ; it is emarginate

with the lobes rounded, the lower lobe being slightly longer than the upper.

N. kashmirensis exhibits sexual dimorphism, but the secondary sexual characters of the male are not so well marked as is the case in several species of the Highlands of Central Asia. The rays of the pectoral fins are broad and bony in the males of *N. kashmirensis*, but tuberculated thickenings are absent on their upper surface. There is a slit-like groove in front of the eye, but there is no tuberculated pad on the head.

The colouration seems to vary considerably with growth. In adult specimens there are broad, black bands on the dorsal surface of the body. They are more marked in the tail region where they extend to the sides also; but anteriorly they become lost in the general mottled colouration of the body. The body is of a dark colour just above and below the lateral line; the upper surface of head is grayish while the entire ventral surface is pale-olivaceous. The dorsal fin is marked with three rows of spots across it, while the caudal fin is provided with about three wavy bands. The ventral and the anal fins are also spotted sometime, while the dorsal surface of the pectoral fins is infuscated with black markings. In the young individuals, besides the saddle-shaped bands on the dorsal surface, there are series of blotches along the lateral line or just below it on both sides. The general surface of the body is irrorated with black dots. In some specimens the body is covered with a number of anastomosing markings which superficially impart a uniform dark colouration to the upper surface and sides of the fish.

Type-specimen :—F10122/1, Zoological Survey of India (Ind. Mus.).

Distribution :—*N. kashmirensis* has been collected in Kashmir from the following localities :—

- (i) Eight specimens from a stream flowing from the waterwork reservoir to the trout-farm at Harwan (*Type-locality*).
- (ii) Seven specimens from a stream flowing out of the Kukarnag Spring.
- (iii) Several young and half-grown specimens from the Verinag Spring.

Remarks.—It has already been indicated that *N. kashmirensis* shows great similarity to species with long and narrow caudal peduncle, such as *N. tenuis*, *N. lhasae*, *N. yasinensis*, etc. The following combination of characters distinguishes it from the allied species :—

- (i) The ventral fin extends considerably beyond the anal opening.
- (ii) The commencement of dorsal is equidistant between tip of snout and base of caudal.
- (iii) The lateral line is complete and well marked.
- (iv) The eye is in the middle of the head.
- (v) The pectoral fin is somewhat shorter than the head.
- (vi) The least height of the caudal peduncle is considerably greater than the diameter of the eye.

N. kashmirensis is further distinguished from all the related species by its general facies and the characteristic colouration.

Measurements in millimetres.

	Stream near trout-farm at Harwan.			Stream flowing out of Kukarnag Spring.		Verinag Spring.	
Total length including caudal	98.5	92.4	77.4	93.8	62.4	55.0	41.2
Length of caudal	16.5	16.2	12.4	15.0	11.4	10.0	7.2
Length of head	17.6	16.0	13.7	17.0	12.2	11.0	8.6
Width of head	12.0	11.8	9.5	12.0	8.2	7.2	5.7
Height of head at occiput	10.0	9.8	7.3	10.6	7.1	6.2	4.8
Depth of body	12.2	13.3	9.0	12.3	8.3	6.2	4.8
Length of snout	7.9	7.7	5.3	7.8	5.6	4.9	3.4
Diameter of eye .	3.2	3.0	2.1	3.1	2.4	2.0	1.7
Interorbital distance	4.9	5.0	3.9	4.8	3.2	2.8	2.6
Length of caudal peduncle	18.3	16.5	16.6	16.5	11.0	10.2	7.8
Least height of caudal peduncle .	5.6	5.5	4.4	5.0	3.3	2.8	2.0
Longest ray of dorsal	12.8	13.0	11.0	13.0	9.5	9.5	6.2
Longest ray of anal .	12.0	10.8	8.5	11.5	7.5	7.0	4.3
Length of pectoral . .	16.5	14.0	13.5	15.6	12.0	10.7	6.4
Length of ventral . .	13.2	12.4	10.8	13.5	9.0	8.5	4.6