RECORDS

of the

INDIAN MUSEUM

Vol. LII, Part I, pp. 1-14.

Garra hughi, a new Cyprinid fish from the Western Ghats, Peninsular India, with notes on its Bionomics.

By

E. G. Silas.

CALCUTTA :

1954

GARRA HUGHI, A NEW CYPRINOID FISH FROM THE WESTERN GHATS, PENINSULAR INDIA, WITH NOTES ON ITS BIONOMICS.

By E. G. SILAS, *N. I. S. I. Research Scholar.*

(*From the Laboratories of the Zoological Survey of India, Calcutta.*)

(Plate IV).

INTRODUCTION.

As has been demonstrated in many recent papers (Hora, 1941 ; Hora & Law 1941 ; Raj, 1941 ; Herre, 1945 ; Silas, 1951), the Western Ghats of Peninsular India, especially the hill ranges lying to the south of the Neilgherries have proved one of the most fertile fields for ichthyological discoveries. From the array of novelities that have been collected from this area in recent years, it would seem that in each of its river systems, especially towards the head-waters of the rivers, the naturalist is bound to come across new forms, or else, new facts pertaining to the status, relationships, bionomics, distribution, etc., of species already known. This is more so with reference to the smaller species. More than one factor is responsible for the paucity of our knowledge of the complete fish fauna of this area. As first may be mentioned the fact that earlier attempts at collecting have been made mainly from a few scattered centres along these hills, with very little importance attached to the nature of the different watersheds, etc. Another drawback has been that in many cases stray collections have been made by collectors, who had no particular knowledge of the habits and habitats of fishes to be found in such environs, and as a result, more often than not, many interesting forms have been overlooked. However, much credit goes to those pioneering efforts which have contributed greatly towards our present knowledge of the fauna.

During the past few years, I have visited these hill-ranges on different occasions, with a view to make a more systematic survey of the fish fauna and some of the results of these investigations have already been reported on. On my last visit to the south in October-November 1952, I spent a short period with my brother Mr. H. M. Silas in the High Range, Travancore-Cochin and made a collection from the streams in and around Periakanal Estate and Surianelle, about 10 miles south of Munnar. Since my return to Calcutta, I have been receiving regularly fish collections made by him from the different parts of the High Range. In the material obtained so far, there are 52 specimens of a species of mountain carp, of the genus *Garra* Hamilton, which has remained hitherto undescribed. In the present paper, a detailed morphometeric study of this new species is undertaken, principally with a view to determine the more precise systematic characters in the genus, and to find the range of variation within individual species limits of certain charac-

ters, which have been earlier widely used for separating species and finally to provide a preliminary data on certain structural changes during growth, which may also help in defining the relationships of the species. Short notes on the ecology and bionomics of the new species are also given.

All the specimens of the new species were collected by Mr. H. M. Silas from a stream in the Lower Vauguvarrai Estate. This stream forms part of the little explored eastern watershed of the High Range. On enquiry, I have received the following information regarding the habitat of the new species of *Garra* described in this paper :—

> " *Lower Vauguvarrai.*—Most of the fish were collected from a large rock-pool called *Lakkum*. Elevation 4500 feet above mean sea level. The pool is very rocky with very little sandy bottom. All along the stream there are plenty of small waterfalls and rapids every 20 or 30 yards. Plenty of vegetation is afforded by the dense forests on either banks. The stream is rough, especially so during the monsoons. Since the fish were caught during day time (between 10 A.M. and 3 P.M.), they were found mostly under or very close to the rocks in the shade"

Garra hughi* sp. nov.

D. 2/7 ; P. 1/11-15 ; V. 1/7-8 ; A. 2/5 ; C. 18-19 ; L. l. 36-39 ; L. tr. 4-5/1/3

Diagnosis.—Garra hughi can be readily distinguished from the other known species of the genus by its elongate body form ; broad head ; broadly rounded snout with no tubercles on it ; the absence of a proboscis and lateral lobes on the snout ; the *total absence* of scales on the ventral surface as far back as, and between the pelvic fins and on the dosal surface generally in a broad streak between the occiput and the origin of the dorsal fin ; the pharyngeals and its teeth and finally in its body colouration.

Description.—This species is remarkable for its slender body form and broad head. The dorsal profile rises gradually from the tip of the snout to midway between the origin of the dorsal fin and the occiput, from whence it slopes gently to the base of the caudal fin. The head and the anterior part of the body are greatly depressed and the ventral surface is flattened as far back as the commencement of the anal fin. The paired fins are broadly rounded and horizontally inserted.

The length of the head is contained 4·222 to 5·588 (typically 4·6 to 5·0) in the total length and 3·444 to 4·307 (typically 3·55 to 3·9) in the standard length. The height of head at occiput is contained 1·272 to 2·0 and the width of head 1·166 to 1·8 in its length. The snout is broadly rounded and smooth and is not produced into rostral lobes in front of, or outside the nostrils. But generally an almost indistinguishable depression or groove is present across the snout passing from one nostril to the other, a condition more or less similar to that found in *Garra lamta mullya* (Sykes). The length of the snout is contained 1·833 to 4·5 (typically 1·8 to 2·8) in the length of the head ; it being considerably shorter in smaller examples. On the sides of the snout there are three or four irregular ows of sensory pores which extend from its anterior border to below and behind the eye and in larger examples even to the opercular region. Tubercles are absent on the snout. The nostrils are situated externally and are placed much closer to the eye than to the tip of the snout. The

*I have great pleasure in naming this new species after my brother Hugh M. Silas.

anterior nostril is tubular while the posterior nostril is covered by a rectangular skin flap.

The eyes are small and are situated dorso-laterally, but are not visible from below. They are comparatively larger in smaller examples and this is best expressed by giving the ratios resulting from stepping the diameter of the eye into the length of the head. The total range for the sample examined is 3·25 to 7·5. In specimens 15 to 36 mm. in total length the range is from 3·25 to 4·25, while in larger examples measuring 37 mm. and upwards the range is from 4·25 to 7·5 (typically 5·0 to 6·6). The diameter of the eye is also contained 0·8 to 4·0 in the length of the snout (typically 0·8 to 2·75 in small examples ranging from 15 to 37 mm. in total length and 2·5 to 4·0 in specimens more than 37 mm. in total length). The inter-orbital distance is broad and slightly convex in small examples while in larger examples measuring over 40 mm. in total length it is almost straight, the upper margin of the orbit approaching the upper profile. The diameter of the eye is contained 1·166 to 3·25 in the interorbital distance (typically 1·2 to 1·6 in small examples measuring 15 to 36 mm. in total length and 2·0 to 3·25 in larger examples). Concomittant with changes in the relative length of the snout and the diameter of the eye during growth, variations are to be expected in the position of the eye in relation to the head length. This is so, for in examples measuring less than 40 mm. in total length, the eye is situated closer to the tip of the snout than to the posterior margin of the head and the pupil of the eye is also entirely in the anterior half of the head. In examples measuring between 40 and 49 mm. in total length, the eye is situated more or less in the middle of the head and so also, the pupil of the eye. In larger examples, with the elongation of the snout, the eye is in a position closer to the posterior margin of the head than to the tip of the snout. The pupil of the eye is also placed entirely in the posterior half of the head.

The mouth is broad and almost straight. The gape of the mouth is contained 1·6 to about 2·5 times in the length of the head (the mouth is comparatively less wider in smaller examples). The mouth is placed just behind the tip of the snout in small examples while in larger specimens it assumes a position slightly behind the tip of the snout, the rostral fold overhanging it. The upper jaw is almost completely covered by the rostral fold which has its ventral surface minutely striated in a longitudinal direction and the striae in the center bear minute papillae. The edge of the fold is uniformly fimbriated. The lower lip is broad and straight and does not bear any papillae. The adhesive disc in young examples measuring upto 25 mm. in total length is about as broad as long, and once it is well formed, (by about the 30 mm stage) there is very little variation in its structure. In larger examples the disc is broader than long, its length being contained 1·142 to 1·625 in its width. The shape and structure of the disc which varies in specimens less than 25 mm. in length, generally agrees with stage 7 as figured by Hora (1921, text figure 1, p. 640). In larger examples the disc consists of an anterior trans-verse band of soft tissue which is profusely papillated and is slightly directed backwards at the extremities. Anterio-

lateral to either extremity of it and posterior to the lower lip, at about the angle of the mouth there is on each side a small triangular papillated band. The central fleshy broad pad or disc-proper is very minutely and sparcely papillated, giving it the appearance of a more or less cartilagenous disc. This true disc is fringed by a narrow band of soft papillated integument, which is laterally and posteriorly free.

Two pairs of barbels are present. The rostral barbel is about 0·6 to 0·75 the length of the diameter of the eye. The maxillary pair which is borne on either corner of the mouth is short and stumpy, its length being only about 0·5 to 0·75 the length of the rostral barbel. A deep groove runs from slightly above the base of the rostral barbel to the angle of the mouth.

The gill-openings are fairly wide and extend to the ventral surface for a short distance. The isthmus on the ventral surface between the gill clefts is broad and is contained 1·5 to 1·9 in the length of the head. The opercular bones are followed by a narrow fleshy marginal flap posteriorly, the flap being wider near the upper angle of the gill-opening.

The greatest height of the body is about midway between the occiput and the origin of the dorsal fin. It is contained 5·9 to 8·0 (typically 6·2 to 7·8 in large examples) in the total length and 4·6 to 6·454 in the standard length (typically 5·0 to 6·3). The body is broadest behind the gill openings, between the bases of the pectoral fins. The width of the body is contained about 1·2 to 2·0 in the length of the head ; 6·545 to 9·5 in the total length and 5·272 to 7·5 in the standard length. It is almost equal to the height of the body at the origin of the dorsal fin. The caudal peduncle is elongated and narrow, its least height being contained 1·5 to 2·0 in its length.

The dorsal fin is as high as the height of the body below its origin. Its last undivided ray is soft, slender and is articulated in its distal two-thirds. The free margin of the dorsal fin is slightly concave and the length of the last branched ray is equal to about 0·75 the length of the last undivided ray. The height of the dorsal fin is contained 1·25 to 1·714 in the length of the head. The origin of the dorsal fin is slightly ahead of that of the pelvic fin, and in adult specimens it is opposite the 12th or 13th perforated scale of the lateral line, while the origin of the pelvic fin is generally opposite the 14th or 15th perforated scale of the lateral line.

The length of the pectoral fin is equal or slightly less than the length of the head ; it being contained 1·0 to 1·666 in the latter. When adpressed the pectoral falls short of the pelvic fin by about one-third its own length or about half the length of the pelvic fin. Above the base of the pectoral fin and behind the lower half of the gill-opening there is an almost triangular muscular pad which is devoid of scales. The number

of pectoral fin rays range from 1/11(12) to 1/15(16) (typically 1/14-1/15) and its frequency distribution is given in table I.

TABLE I.

Frequency distribution of the number of pectoral fin rays, lateral line scales and scales round coudal peduncle in Garra hughi, sp. nov.

Character.	Total Range.	Counts in Holo-type.	Total No. of speci-mens.	Mean $\pm \sigma_M$	Percentage.		
1. No. of pectoral fin rays.	12—16	14	43	14·488±·107	12—13	14—15	16
					9·3	81·39	9·3
2. No. of lateral line scales.	36—39	38	34	37·735±·012	36—37	38—39	
					29·41	70·58	
3. No. of scales round caudal peduncle.	13—15	14	19	14·105±·010	13	14	15
					5·26	78·94	15·79

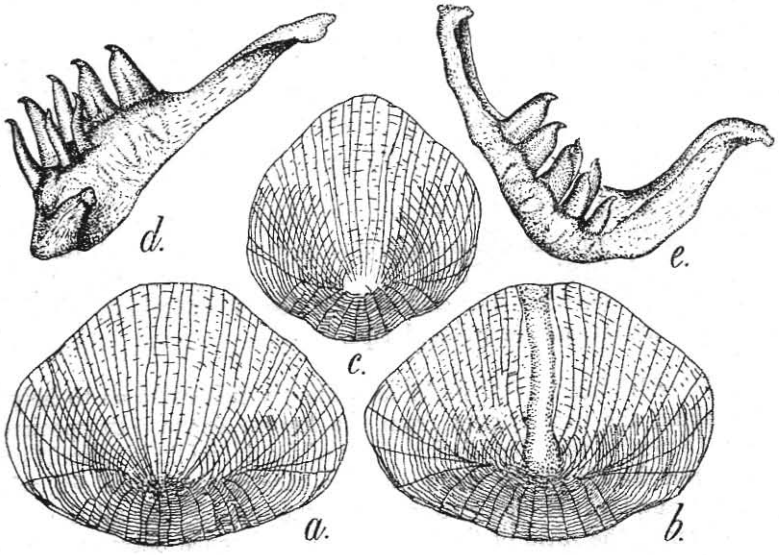
The outer four to five rays of the pectoral fin have thick fleshy muscular pads on their ventral surface to help in adhesion. The number of pelvic finrays range from 1/7 to 1/8, the holotype having the count 1/7 The pelvic fin reaches or slightly overlaps the anal opening, but falls considerably short of the origin of the anal fin. The length of the anal fin is contained 1·269 to 1·666 in the length of the head. The anal fin is shorter than the pelvic fin and its longest ray is 1·5 to 1·875 times in the length of the head. The last branched anal ray is about half the length of the last undivided ray. The anal fin has 5 branched rays and 2 undivided rays. The caudal fin is slightly longer than the head, its length being contained 4·181 to 5·75 in the total length and 3·181 to 4·75 in the standard length. The caudal fin is deeply emarginate, the lobes being equal and ending in pointed tips.

Certain additional body proportions are given here so as to help in distinguishing the new species from the known forms. In specimens less than 45 mm. in total length the origin of the dorsal fin is almost midway between the tip of the snout and the base of the caudal fin, while in larger examples it is closer to the tip of the snout. For all the specimens examined the ratio of the range of the distance between the tip of snout and origin of dorsal as stepped into the distance from the origin of the dorsal to the base of the caudal fin is 0·95 to 1·148. The former is also contained 1.875 to 2.111 and the latter 1·838 to 2·09 in the standard length. The commencement of the pelvic fin in specimens less than 45 mm. in total length is much closer to the base of the caudal fin, while in larger examples it is almost midway between the tip of the snout and the base of the caudal fin. When compared against the standard length the ratios obtained are 1·812 to 2·058 for the distance from the tip of the snout to the origin of the pelvic fin, and 1·944 to 2·44 for the distance from the origin of the pelvic fin to the base of the caudal fin.

[1] The count of 1/8 rays in the pelvic fin was observed in two specimens (one on the right side only and the other in both the pelvic fins.)

The vent (anal opening) is considerably removed from the anal fin and the distance between the vent and the origin of the anal fin is contained 3·5 to 4·2 times in the distance between the origins of the pelvic and anal fins. The anterior origin of the anal fin is much nearer to the base of the caudal fin than to the origin of the pelvic fin.

One of the most outstanding characters in the new species is the nature of the lepidosis and squamation. The scales are fairly large, non-deciduous and the lateral line is conspicuous. The scales along the lateral line range from 36 to 39 (typically 37 to 38 *vide* table I). The lateral line gently curves down just behind its origin in a line above the pectorals (in some it is almost straight) and runs straight to the middle of the base of the caudal fin. In a vertical below the origin of the dorsal fin, the lateral line is slightly nearer to the ventral than to the dorsal surface, while on the caudal peduncle it is equidistant from both. There are 3 rows of scales between the lateral line and the origin of the pelvic fin and 4 to 5 rows of scales between the origin of the dorsal fin and the lateral line. The scales round the caudal peduncle number 13 to 15 and their frequency distribution is given in table I.



TEXT-FIGURE 1.—Scales and pharyngeals and their teeth in *Garra hughi* sp. nov.

a. Scale from above lateral line midway between head and vertical from origin of dorsal. × 10.

b. Scale from lateral line from a vertical below origin of dorsal fin. × 10

c. Scale from caudal peduncle above lateral line. × 10

d. Inner view of pharyngeals and teeth taken from paratype. × 12½

e. Dorso-lateral view of the same. × 12½

The scales are *totally absent* on the ventral sufrace as far back as, and between the base of the pelvic fins. In a few specimens the scaleless area extends still further backwards to the origin of the anal fin. But generally in this post-pelvic area a few ill-defined scale, almost completely embedded in the skin can be made out on careful examination. On

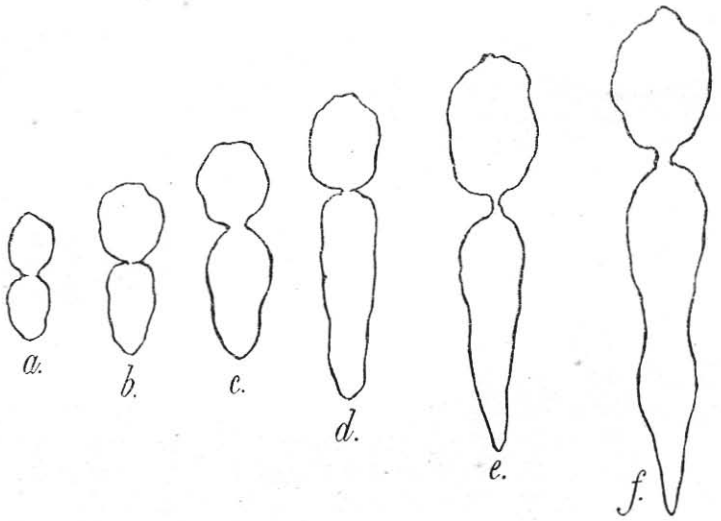
the dorsum, the scales are generally absent in a broad streak from the occiput to the origin of the dorsal fin. In a few examples the scaleless area is seen to extend along the entire dorsal surface as a broad streak from the occiput to the base of the caudal fin. This condition has been figured from one of the paratypes *vide* (Plate, I, figure 4). In such specimens careful examination has shown the presence of two or three scattered scales almost completely embedded in the integument in the post-dorsal region. In a few small examples rudimentary scales are also noticeable in part of the predorsal area, generally more towards the base of the dorsal fin.

The shape and structure of the scale differs considerably from that described and figured by Chu (1935) for *Garra imberba* (Garman) and *Garra schismatorhyncha* (Nichols & Pope) from China. As such, I have considered it best to present here the salient features of the scale of the new species which might prove taxonomically important in species distinction. The scales were examined in a number of specimens, but were found to adhere more or less to the general pattern as figured and described here for a paratype measuring 56 mm. in standard length. Generally the scales are roundish or vertically elliptical. The anterior margin is broadly rounded while the basilateral angles are round or slightly produced laterally. The focus is basal in position. The scales on the sides of the body are broader than long, while those on the caudal peduncle are slightly more elongate than broad. Both basal and apicolateral radii are present in all the scales. In the scale from the side of the body above the lateral line, in a vertical midway between the occiput and the dorsal origin (Text figure 1, *a*) the basal radii number 15 while the apicolateral radii, both complete and incomplete, number 36 (27 plus 9). In the second scale from the lateral line, taken from a vertical below the origin of the dorsal fin (Text figure 1, *b*), the basal radii number about 12, while the apicolateral radii number 31 (23 plus 8). In the third scale taken from the side of the caudal peduncle above the lateral line (Text figure 1, *c*), the basal radii number 12 while the apicolateral radii number about 31 (22 plus about 9). In these scales, 12 to about 16 circuli are present basally, while the number of lateral circuli range from about 20 to 32. In all the body scales, the apical circuli are indistinct and degenerate. No tubercles or granular prominences are evident on the apical portion of the exposed field.

The pharyngeals are rather long, its width being contained about four times in its length (Text figure 1, *d* and *e*). The anterior and posterior limbs are of about the same length. The pitted surface is broad in the middle, but does not continue forward to the tip of the anterior limb. The teeth are arranged in two rows, the formula being 5·2-2·5. They are placed fairly close together and are conical with the tips uncinate or slightly recurved posteriorly. The outer row of teeth is enlarged and the grinding surface is more or less oblique.

The gas-bladder is comparatively reduced, but is of the normal cyprinid type. From the material examined it is evident that there is a considerable change in the structure, shape and size of this organ in the species, during different stages of growth. From the data given in

Table II, it will be noticed that in *Garra hughi* there is a general tendency for the decrease in the size of the gas-bladder as growth of the specimen increases resulting in a negetive correlation. Besides the size and the shape (Text figure 2*a-f*), the structure of the gas-bladder also undergoes certain changes. In small specimens both the anterior and posterior chambers are thin walled and large, while in larger examples the condition deviates considerably from this original type. The anterior chamber is reduced and is fixed to the body wall by a fibrous coat, while the posterior chamber becomes more narrower, cylindrical and thick-walled, the lumen inside being greatly reduced. Hora (1921, 1922) has pointed out the significance of the reduction of the gas-bladder in ' loach-like ' hill stream fishes and has correlated it with the ' ground habit of life ' of the fish.



TEXT-FIGURE 2.—Figure showing changes in the size and shape of the gas-bladder during growth in sepcimens of *Garra hughi* sp. nov. ×4.
a. Gas-bladder from a specimen 12 mm. in standard length.
b. Gas-bladder from a specimen 15 mm. in standard length.
c. Gas -bladder from a specimen 21 mm. in standard length.
d. Gas-bladder from a specimen 31 mm. in standard length.
e. Gas-bladder from a specimen 44 mm. in standard length.
f. Gas-bladder from a specimen 57 mm. in standard length.

TABLE II.

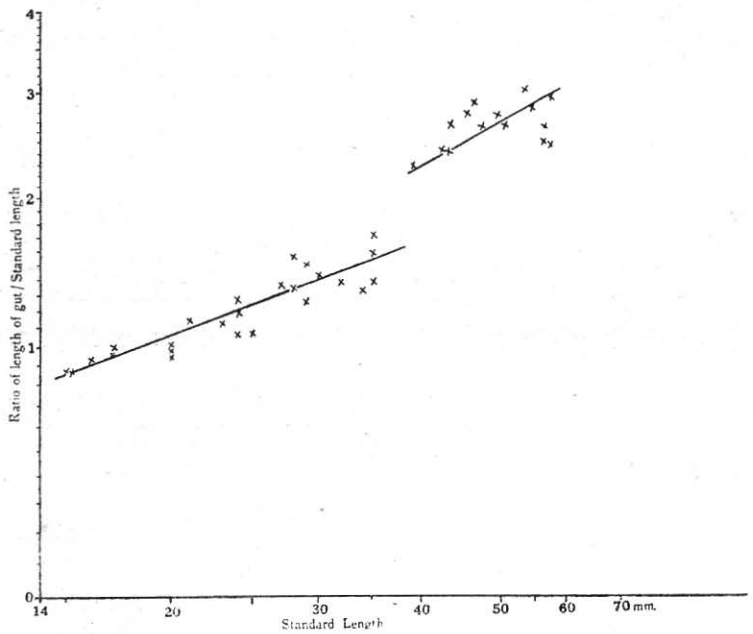
Table giving the relative lengths of the gas-bladder as compared against the standard length in six specimens of Garra hughi sp. nov.

Standard length in mm.	Length of gas-bladder.	Length of anterior chamber.	Width of anterior chamber.	Length of posterior chamber.	Width of posterior chamber.	St. length / Length of anterior chamber.	St. length / Length of posterior chamber.	St. length / Total length of gas-bladder
12	4·0	2·0	1·5	2·0	1·5	6·0	6·0	3·0
15	5·0	2·5	2·5	2·5	2·5	6·0	6·0	3·0
21	7·0	2·75	2·5	4·25	2·5	7·63	4·94	3·0
31	10·0	3·0	2·0	7·0	2·5	10·33	4·42	3·1
44	13·0	4·5	3·0	8·5	2·75	9·77	5·17	3·38
57	16·5	5·0	3·0	11·5	2·5	11·40	4·95	3·49

In measuring the anterior and posterior chambers of the gas-bladder, the measurement was carried out to the centre of the constricted portion separating the two chambers.

The comparatively larger size of the gas-bladder in smaller examples of *G. hughi* indicate that they probably are ' free-swimmers' and are found in more calmer waters closer to the banks and in pools and puddles along the course of the stream. The food of the young specimens also indicate that only after a certain stage they really take to the habit of living close to the substratum and graze on algae and slime found on the surface of submerged rocks and stones in the rapid streams, a condition for which the presence of a large gas-bladder will be a definite disadvantage.

The gut contents of 40 specimens (Text-figure 3) ranging from 15 to 57 mm. in standard length were examined to verify the nature of the food taken. It is interesting to find young specimens ranging from 15 to about 35 mm. in standard length, omnivorous in their habits, for the gut of some of the specimens were found stuffed with remains of earthworms, aquatic insects, mostly larvae of Chironomids and Ephimeropterans and bits of filamentous algae and detritus. A similar condition in another species of *Garra* viz., *G. ceylonensis ceylonensis* Bleeker has been recorded by Jones, (1941). He observes that juvenile specimens about two months old are " omnivorous in its diet greatly relishing chopped meat and flesh ". In this case, however the specimens were reared in an aquarium. On account of the presence of only algae in the gut of the larger specimens examined, it is presumed that they feed mainly on vegetable matter. Comparisions



Text-figure 3. Double Logarithmic poit showing the ratios obtained of the length of the gut/standard length of 40 specimens of *Garra hughi* sp. nov. stepped against their respective standard length. The graph demonstrates the significant increase in the length of the gut after about the 35 mm. stage which synchronises with a change in the dietary habits of the species. (The connecting lines are given for visual aid).

of the length of the gut in these specimens in relation to the standard length shows that there is relatively a significant increase in the length of the former after a certain stage during growth. This sudden increase in the length of the gut after about the 35 mm. stage (standard length) thus indicates that the fish after an early life as an omnivorous feeder (predominantly carnivorous) later takes to feeding on vegetable matter (mainly algae) with a change in its mode of living, (*viz.*, from a more free swimming habit in calmer waters to life close to the substratum of the rapid waters of the streams, and this change in diet results in a greater increase in the length of the gut.

Colouration.—Colouration is characteristic, the sides and upper half of the body being greyish, while the ventral side and the abdomen are yellowish white. In young specimens the sides of the abdomen are whitish and the skin of the scaleless area on the abdomen is transparent, through which the coiled alimentary canal and the dark peritonial lining are visible. In some adult specimens the greyish body colour extends to below the lateral line to the level of the origin of the paired fins dorsally. A dark conspicuous lateral band is present commensing from the upper angle of the gill-opening and extending to the base of the caudal fin along the lateral line. A dark blotch is usually present on the lateral line two scales from the base of the caudal peduncle. A second dark band is present along the scaleless area of the dorsum between the occiput and the origin of the dorsal fin. The scales on the upper half of the body, especially towards the dorsum have very dark bases and lighter margins. The fins are dirty white or dusky in colour and the upper surface of the outer rays of the paired fins are coloured dark greyish. In some of the immature specimens the sides of the body are coloured greyish brown and the mid-lateral dark band though present is not so conspicuous

Types.—The Holotype F. 746/2 ; 88 mm. long (77 mm. in standard length). The 51 paratypes F. 747/2 were taken along with the holotype in March 1953. The Holotype and the paratypes are deposited in the collection of the Zoological Survey of India, Calcutta.

Type locality :— Stream in Lower Vauguvarrai Estate, High Range Travancore-Cochin.

In table III, I have given the ratios and the Average of the proportional measurements of 26 characters of the species. The detailed table was prepared so that it might help for future comparisions.

Table III.

Table giving the morphometeric range (expressed as ratios) of 26 characters of Garra hughi *sp. nov.*

Characters.	Range for Holotype and paratypes.	Holotype.	No. of specimens.	Average.
1. Total length/Length of head.	4·222—5·588	5·333	40	4·914
2. Total length/Greatest height of body.	5·900—8·000	8·000	40	6·862
3. Total length/Greatest width of body.	6·545—9·500	8·800	40	8·194

(maxillary pair); triserial pharyngeal teeth (6·3·3-3·3·6); the position of the dorsal fin, the length of the head, height of body, *etc.* it differs considerably from the new species. In *G. abhoyai*, the scaleless condition has been described by Hora (1921, *op. cit.*, p. 664) as follows :—

> "On the sides and on the dorsal surface behind the dorsal fin, the scales are well marked and their boundaries easily distinguishable, while in front of the dorsal fin they are much reduced and, indeed, to the naked eye the surface appears to be absolutely devoid of any scales. The under surface in front of the ventrals. is naked, but ill-defined scales are present between the bases of the ventral and anal fins."

I have examined the type of *G. abhoyai* in the fish collection of the Zoological Survey of India, and find that unlike the new species where the scales are totally absent on the abdomen between and in front of the base of the pelvic fins, ill-defined scales are in fact present and are almost completely embedded in the skin of the abdomen giving the false appearance of scalelessness. Moreover the Assamese species differs from *G. hughi* in the general body form, body proportions, number of lateral line scales, etc. Recently Hora (1953) has pointed out how ' turbulent waters ' in a torrential stream (contrasted with rapid-flowing waters) resulting from the melting of the snows or due to orogenic movements or heavy rainfall, could bring about the reduction in the scales or even the total absence of scales in the body of fishes. As examples may be cited many of the Schizothoracine fishes and the Cobited fishes of the Himalayas and the Central Asiatic Plateau. In *Garra* we find that such specialisation has taken place in three widely separated species. There is no doubt that this convergent similarity clearly reflects the effect of like responses to similar environment.

Conclusion.

During the past 33 years, since the publication of the last comprehensive work on the genus by Hora in 1921, a considerable amount of literature has accumulated on the taxonomy of these fishes, and many new species have been described by different authors from countries adjacent to India. A study of the literature shows that particular emphasis has been placed by taxonomists on certain characters not all of which; it is felt, are significant for separating species. However, it is evident that the materials on which they had to work on was mostly limited, so much so, primary importance seems to have been attributed to characters which are sometimes highly variable even within species limits. In many instances the variations which have formed the basis for species differentiation credit only racial or subspecific status. The present study and the assessment of the characters used in segregating species by earlier authors show that the length, width and height of head; the nature of the snout (not length); the presence or absence of proboscis and lateral lobes on the snout; the number of barbels; height of body; fin ray counts, lepidosis and squamation; position of the vent in relation to the origins of the pelvic and anal fins and the pharayngeals and their teeth are more dependable characters in the genus *Garra*. Much caution has to be exercised in using characters like the position of the eye in relation to head length; length of snout; origin of the dorsal and pelvic fins in relation to standard length;

nature of the adhesive disc, *etc.* as they are found to vary considerably both during growth as well as in specimens of about the same length in individuals of the same species itself. The maze of species that are known at present to constitute the genus *Garra*, seems difinitely separable into different species groups including polytypic species with infraspecific levels of differentiations and only a taxonomic approach based on the present day species concept will help to clarifying the confusion that still exists in the taxonomy of this genus. Besides one other factor which needs elucidation is the redescription and the fixing of the precise range of distribution of the genotype, *Garra lamta* Hamilton, so that comparisions to it of spatially widely separated forms which have erroneously either been denoted as *G. lamta* or have been assigned other specific names, can be carried out. A study of the genus *Garra*, based on these lines is likely to make clear the phylogenetic affinities of the group ; the inter-relationships of the different species groups and finally give us a better idea of its distributional pattern.

ACKNOWLEDGEMENT.

I am greatly indebted to Dr. S. L. Hora, Director, Zoological Survey of India, for his helpful suggestions in the preparation of this paper. To my brother, Hugh M. Silas, Assistant Manager, Periakanal Estate, I am grateful for his constant help in the field during my visit to the High Range in 1952, and for the great pains he has taken for visiting and making fish collections for me from the different parts of the High Range over the past year.

REFERENCES.

ANNANDALE, N. 1919.—Notes on fish of the genus *Discognathus* from India and Persia. *Rec. Ind. Mus.*, XVIII, pp. 65-78.

ANNANDALE, N., AND HORA, S. L. 1920.—The Fish of Seistan. *Rec. Ind. Mus.*, XVIII, pp. 161-168.

CHU, Y. T. 1935.—Comparative studies on the scales and on the pharyngeals and their teeth in Chinese Cyprinids with particular reference to taxonomy and evolution. *Biol. Bull. St. John's Univ. Shangai*, No. 2, pp. 1-225.

HERRE, A. W. C. T. 1945.—Notes on Fishes in the Zoological Museum of Stanford University. XX. New Fishes from China and India, a new genus and a new Indian record. *Journ. Washington Acad. Sci.*, XXXV, pp. 399-404.

HORA, S. L. 1921.—Indian Cyprinoid Fishes belonging to the genus *Garra* with notes on related species from other countries. *Rec. Ind. Mus.*, XXII, pp. 634-687.

HORA, S. L. 1922.—Structural modifications in the fish of mountain torrents. *Rec. Ind. Mus.*, XXIV, pp. 31-61.

HORA, S. L. 1941.—Homalopterid Fishes from Peninsular India. *Rec. Ind. Mus.*, XLIII, pp. 211-232.

HORA, S. L. AND LAW, N. C. 1941.—The freshwater Fish of Travancore. *Rec. Ind. Mus.*, XLIII, pp. 233-256.

HORA, S. L. 1953.—Evolution of Torrential Environment in South Eastern Asia. *Bull. Nat. Inst. Sci. India.* No. 5 (Seen in MS.)

JONES, S. 1941.—Larval Development of *Garra ceylonensis ceylonensis* (Bleeker). *Rec. Ind. Mus.*, XLIII, pp. 177-120.

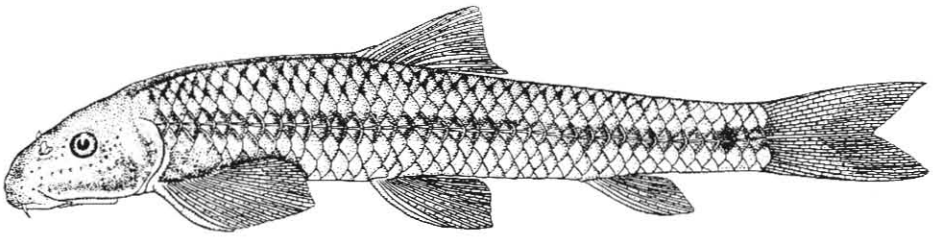
SILAS, E. G. 1951.—On a collection of fish from the Annamalai and Nelliampatti Hill Ranges, Western Ghats, with a note on its zoogeographical significance. *Journ. Bombay Nat. Hist. Soc.*, XLIX, pp. 470-481.

SILAS, E. G. 1951.—Fishes from the High Range of Travancore. *Journ. Bombay Nat. Hist. Soc.*, L, pp. 223-230.

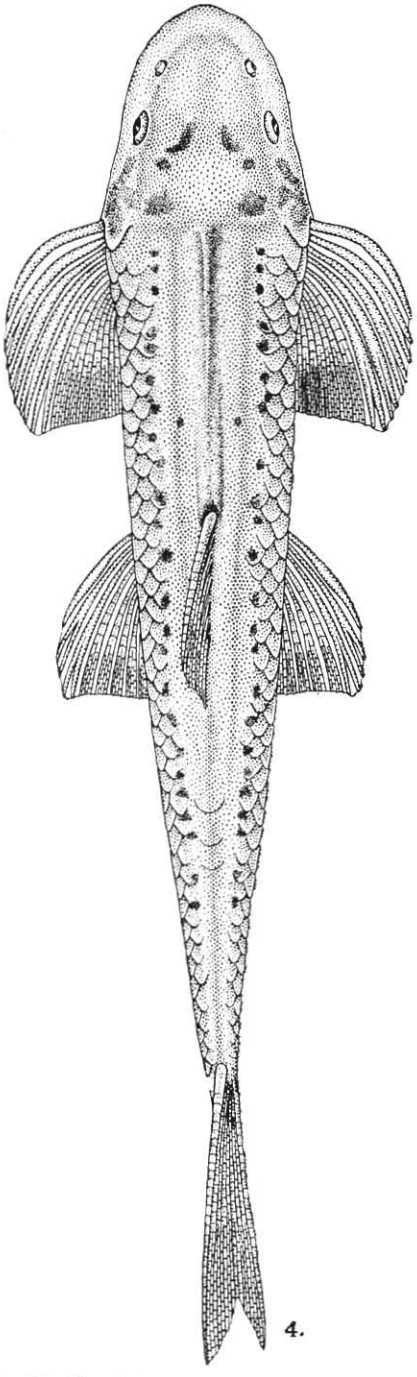
EXPLANATION OF PLATE. IV.

Garra hughi sp. nov.

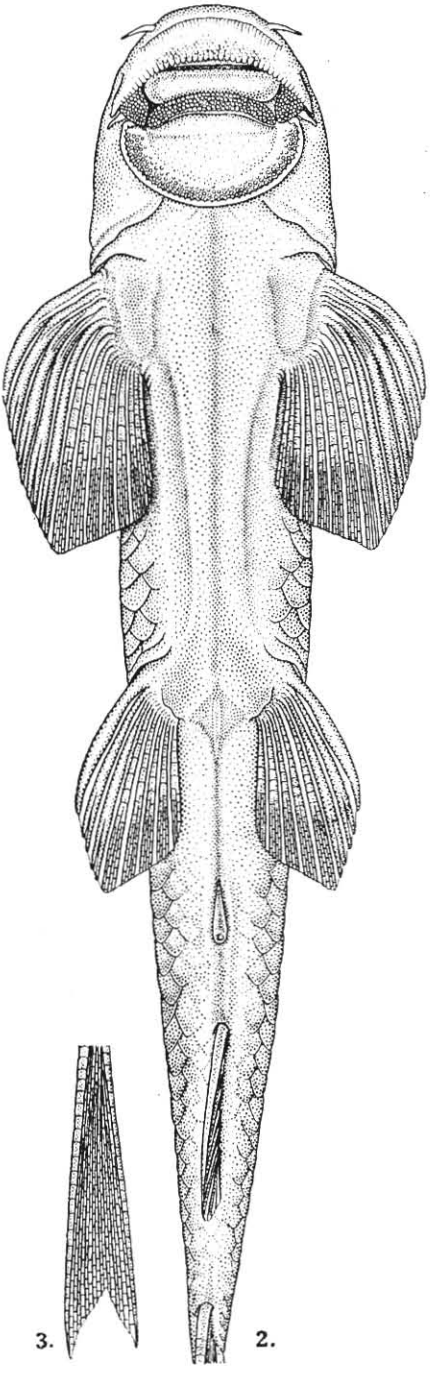
1. Lateral view of holotype measuring 88 mm. in total length. $\times 1\frac{1}{3}$.
2. Ventral view of same. $\times 2\frac{1}{2}$.
3. Portion of caudal fin of figure 2 drawn to same scale.
4. Dorsal view of paratype measuring 77 mm. in total length, showing the absence of scales in a broad streak across the dorsum, from the occiput to the base of the caudal fin. $\times 2.\frac{2}{3}$.



1.



4.



3. 2.

del: R. Bagchi

Garra hughi, sp. nov.