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Classification, Bionomics and Evolution of Homalopterid Fishes.

By

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CLASSIFICATION, BIONOMICS AND EVOLUTION OF HOMALOPTERID FISHES.

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INTRODUCTION.

The Homalopteridae constitute a remarkable family of Cyprinoid fishes which have undergone a great variety of adaptive modifications induced by the necessity of living in swift currents of the torrential streams of Southern Asia. From a study of the characters and mode of life of these fishes, extending over a number of years, it seems clear to me that

the diagnostic features, by which the family is divided into genera and species, are the result of a series of gradual changes, which, by enabling the fishes to adjust themselves to the increasing severity of the external conditions of their existence, have rendered them capable of colonizing the tempestuous currents of mountain streams. In an earlier paper (Hora, 1930) on the 'Ecology, Bionomics and Evolution of the Torrential Fauna' evidence was adduced to show that in the case of a torrential population evolution is no more than the adaptation of organisms to environment. The object of the present paper is to indicate, by an intensive study of a group of animals from various aspects, that, with a knowledge of their ecology and bionomics, the diversity of some of their highly specialised and complicated structures can be readily understood in terms of their utility to the individuals concerned. It is worth while to remember that so long as we are ignorant of the factors constituting what is known as an environment, it is futile to lay too much stress on the characters of the animals inhabiting it, more especially with reference to their utility and evolution.

Another fundamental fact that has become still further impressed on my mind from a study of the Homalopterid fishes is that organisms related in general structure exhibit in the same or similar environment different modifications in structure or form, and that these modifications are related to the same element in the environment. If this principle is of universal application, as I believe it to be, then the study of the correlation of animal characters with the factors in their respective habitats becomes of the utmost importance, and the old idea of guessing the function of a structure from its form, etc., becomes obsolete and highly misleading.

In all work on ecology and bionomics it is necessary to have a sound classification of the animals to be considered. With this object in view considerable pains have been taken to elucidate the taxonomy of the Homalopteridae by an examination of the material in various museums of Europe, and by obtaining specimens in exchange from the American Museum of Natural History and the Metropolitan Museum of Natural History, Academia Sinica (Nanking). During 1928-29, I examined the Homalopterid fishes in the collections of the British Museum (Nat. Hist.), the Zoologisches Museum der Universität, Berlin, the Zoölogisch Museum, Amsterdam, the s'Rijks Museum van Natuurlijke Historie, Leiden, the Museo Civico di Storia Naturale, Genova and the Muséum National d'Histoire Naturelle, Paris. In 1930, an opportunity was taken to revise and enlarge the manuscript by a re-examination of the material preserved at London, Paris, Leiden and Amsterdam. It has been possible in this way to clear up some of the most difficult points in the taxonomy of the Homalopteridae.

In this paper the Homalopteridae are divided into two subfamilies—the Homalopterinae comprising six genera, which contain about 31 species, and the Gastromyzoninae, which is represented by 11 genera having in all about 16 species. In the Homalopterinae 4 new species belonging to the genera *Homaloptera* and *Lepturichthys* and 2 new varieties of *Balitora brucei* Gray are described; whereas, among the Gastromyzoninae no new species has been discovered, but in order to classify the existing species properly 5 new genera have been proposed in this paper. Of the two subfamilies, the Homalopterinae is the better known and the relationships of its various genera are readily distinguishable. Only one genus of this group—*Sinohomaloptera*, is monotypic, but fortunately the species is known

from several specimens. In the Gastromyzoninae there are 9 monotypic genera and most of them are known from scanty material ; consequently, the relationships and phylogeny of the specialised genera of this subfamily are obscure. In recent years many interesting and highly modified forms have been discovered in China and the adjacent countries, and in this connection Mr. F. W. Fang's contributions deserve to be specially mentioned. I feel confident that many more interesting forms, especially belonging to the Gastromyzoninae, still remain to be discovered in the countries between Borneo, Java and Sumatra on the one hand and China on the other.

No attempt has been made to describe each and every species, but, wherever an amplification of the existing description was justified, the species is either redescribed or a note is given on some of its salient features. From an examination of the old material at Paris, Leiden and Amsterdam it has been possible to give synonymic lists of the earlier species of *Homaloptera*. In this connection tribute must be paid to Prof. Max Weber and Dr. L. F. de Beaufort for the excellence and accuracy of their descriptions of the fishes of this family from the Indo-Australian Archipelago. So far as possible I have given synoptic tables to distinguish genera and species, and an attempt has been made to illustrate as many diverse forms as possible in order to facilitate reference in future.

In the section of the paper dealing with the bionomics and evolution of the Homalopteridae some of the characteristic structures of these fishes have been selected for treatment and the diversity of their form and build is correlated with factors in their environment. Attention is repeatedly directed to the communal convergence that is exhibited by these fishes and to the series of characters showing parallel development in the members of the two subfamilies.

The list of literature at the end is mainly concerned with the papers referred to in the text, but it can be taken as a fairly complete bibliography of the family.

The final manuscript of this paper was prepared in the British Museum which possesses the finest and largest collection of these fishes. Mr. J. R. Norman placed the whole of this material at my disposal for examination, and I have to offer him my best thanks for this and for facilities extended to me for work in his department. At Amsterdam I received great help from Dr. L. F. de Beaufort, and during a short visit to Eerbeek Prof. Max Weber very kindly gave me all his time for discussing certain points in the taxonomy of these fishes. To these two gentlemen I am further indebted for translating the Dutch descriptions of the earlier Homalopterid species. It gives me great pleasure to offer to them my sincerest thanks. Further I am indebted for the fullest measure of assistance received from Mr. F. P. Koumans at Leiden, Prof. L. Roule at Paris, Dr. E. Ahl at Berlin and Dr. D. Vinciguerra at Genova.

At my request Dr. H. M. Smith very kindly sent to me his collection of the Homalopterid fishes from Siam for study. I am greatly indebted to him for affording me an opportunity to study this interesting material.

I have to express my gratitude to Lt.-Col. R. B. S. Sewell, Director, Zoological Survey of India, for the facilities he gave to me for this work. A large number of drawings illustrating this paper were drawn by the artists of the Zoological Survey of India with their usual skill and care and I take this opportunity to express to them my thanks.

CLASSIFICATION.

Family **Homalopteridae.**

The family Homalopteridae comprises small Loach-like fishes which inhabit the mountain streams of Southern Asia. In this group of fishes the head and the anterior part of the body are moderately or greatly depressed and the ventral surface is flattened. The pectoral and the ventral fins are horizontally inserted; and are broad, fan-shaped and many-rayed. A number of their outer rays, which, with the exception of the outermost one, are either simple or forked, are flattened and graduated, and are provided with adhesive pads on their ventral surface for the purpose of enabling the fish to adhere to rocks in swift currents. The mouth is subterminal or inferior; the premaxillaries exclude the maxillaries from the gape of the mouth. There are at least 3 pairs of small barbels, two rostral and one maxillary. The pharyngeal teeth are conical and are arranged in a single series; their number varies considerably. The air-bladder is greatly reduced and is divided into two lateral chambers, each of which is enclosed in a bony capsule. The dorsal and the anal fins are short; the former is situated opposite the ventrals. The body is covered with small, cycloid scales which are absent on the head and on a part or whole of the flattened ventral surface. The lateral line is well marked and always extends to the base of the caudal fin. The gill-opening is either narrow, entirely above the base of the pectoral fin, or is of moderate size, extending for a short distance on to the ventral surface. The gill-membranes are united with the isthmus and the pseudobranchiae are absent.

Though the depressed form and the horizontal position of the paired fins was emphasized by van Hasselt in his characterization of the genus *Homaloptera* in 1823, the true significance of these characters was not realized until 1860, when Bleeker used them in elevating *Homaloptera* along with *Psilorhynchus* and *Lissorhynchus* to the rank of a subfamily among Cyprinoid fishes. Bleeker had no material of *Psilorhynchus* and *Lissorhynchus* for examination, and, consequently, he based his diagnosis of the subfamily "Homalopteraeformes" on the species of *Homaloptera* of which he had abundant material in the Dutch East Indies. In his *Atlas Ichthyologique* (Vol. iii, p. 15) Bleeker considered "Homalopteroïdes" as a distinct family and included in it *Homaloptera* and *Psilorhynchus*. He had then become aware that his genus *Lissorhynchus* was a synonym of *Garra* Ham. Buch. (=*Discognathus* Heckel), which is a true Cyprinid genus. According to Bleeker "La petite famille des Homaloptéroïdes se distingue parfaitement bien des autres familles de Cyprins par la position centrale de la bouche à la surface inférieure de la tête. Cette bouche ne s'étendant pas jusqu'aux côtés de la tête, ne forme pour ainsi dire qu'un trou central, tandis que dans tous les Cyprinoïdes ou le museau s'étend plus ou moins horizontalement en avant de la bouche, celle-ci prend toute ou presque toute la largeur de la tête. On trouve un autre trait caractéristique de cette famille dans la structure des nageoires pectorales, dont les rayons antérieurs, au nombre de 4 jusqu'à 7 ou 8, sont simples, caractère qu'on ne retrouve dans aucun poisson de autres familles de Cyprins" The last character must have influenced Bleeker in retaining *Psilorhynchus* in the family Homalopteridae for he observes that, "Les figures que MacClelland a publiées du Psilorhynchus variegatus et du Psilorhynchus sucatio font croire que ces poissons ont aussi les premiers rayons de pectorales non divisés comme les espèces du genre Homaloptère" Günther (1868) also included *Psilorhynchus* along with

Homaloptera in his group Homalopterina, though later authors did not place it in the Homalopteridae. The systematic position of the genus *Psilorhynchus* has been a matter of considerable doubt until recent years. In 1925, it was pointed out (Hora, 1925) that *Psilorhynchus* was quite distinct from all the other families of the Cyprinoid fishes and a new family Psilorhynchidae was proposed to accommodate it. The absence of barbels and the presence of a free air-bladder in the abdominal cavity separate Psilorhynchidae from the Homalopteridae.

There is another Cyprinoid genus—*Gyrinocheilus* Vaillant (1902, 1902a)—without barbels and with a free air-bladder in the abdominal cavity which is still included by some (Tchang, 1930) in the family Homalopteridae. In 1923, I discussed its position among Cyprinoid fishes and proposed for it a separate family—Gyrinocheilidae—which was characterized, besides the two characters mentioned above, by the presence of slender, toothless lower pharyngeals, the remarkable modifications of the gill-opening to form inhalent and exhalent apertures and the structure of the mouth, lips and jaws. The Gyrinocheilidae seems to be more closely related to the Cyprinidae than to any other family of the Cyprinoid fishes.

Of the other genera that are usually included in the Homalopteridae[1], *Octonema* Martens (1868) and probably *Glaniopsis* Boulenger (1899) belong to the Cobitidae. *Octonema* is known from a single species—*O. rotundicauda* Martens—from Hongkong. I have examined 2 typical specimens of this species in the Zoologisches Museum der Universität, Berlin, and I am of opinion that they belong to the genus *Nemachilus*. The body is rounded and subcylindrical and is covered with minute scales. The lateral line pierces a few scales at the anterior end. The pectoral fin is small, not horizontally inserted and is provided with a small number of rays of which one anterior ray is simple. The mouth is almost terminal and is bordered by 6 long barbels of the *Nemachilus*-type. In these characters, and also in the presence of nasal barbels, the position of the ventrals considerably in advance of the dorsal, the position of the anal-opening and the colouration, the type-specimens of *Octonema rotundicauda* resemble very closely *Nemachilus obesus* Vaillant (1902*a*) from Borneo. The genus *Octonema* was based on an additional pair of nasal barbels in *O. rotundicauda*. I have indicated in the case of the species of *Nemachilus* that this character is of little value.

Glaniopsis was defined by Boulenger (*op. cit.*) as follows :—" Head and anterior part of body depressed ; snout scarcely projecting beyond the mouth, which is moderately large ; five pairs of barbels—two in front of the snout, two at the angle of the mouth, and one between the two nasal openings ; gill-openings narrow. Body covered with small scales ; head naked ; lateral line present. Dorsal fin short, further back than base of ventrals ; anal short ; pectoral and ventral fins horizontal, many-rayed, the outer rays simple. Well distinguished from *Homaloptera* by the presence of a nasal barbel."

As I have indicated above in the case of *Octonema*, the presence of nasal barbels cannot be regarded as a character of generic value among Loaches. The presence of 2 barbels at each angle of the mouth, coupled with the presence of well marked nasal barbels, is sufficient,

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[1] Jordan in his *Classification of Fishes* (p. 145) has included *Ellopostoma* Vaillant (*Notes Leyden Mus.* XXIV, p. 145, 1902) in the family Homalopteridae. The nature of the pharyngeal teeth and air-bladder of this genus is unknown. But so far as can be judged from the available descriptions and figures, *Ellopostoma* cannot be regarded as a genus of the Homalopteridae.

however, to characterize *Glaniopsis*. I have examined the two typical specimens of *G. hanitshi* in the collection of the British Museum. In their general build and facies they resemble certain torrent-inhabiting species of *Nemachilus*. Their almost terminal mouth, the plain and fleshy lips, the long barbels and the beaked condition of the jaws, especially of the upper one, indicate close relationship between *Glaniopsis* and *Nemachilus*. In *Glaniopsis* the head and the anterior part of the body are feebly depressed and the gill-opening extends on to the ventral surface for a short distance. The pectoral fin contains 13 to 14 rays, of which one outer ray is simple. The ventral fin contains 8 rays, of which 1[1] outer ray is simple. The flattened ventral surface is devoid of scales.

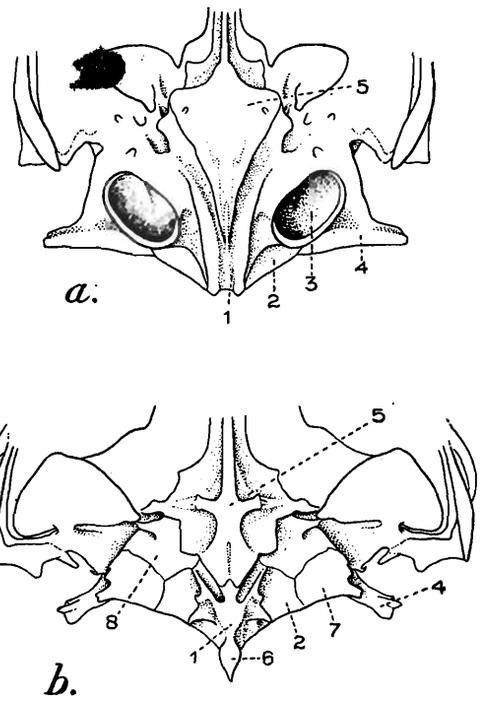
Besides *Octonema* and *Glaniopsis* there are two other genera among Loaches—*Elxis* Jordan and Fowler (1903) and *Lefua* Herzenstein (1888)—which possess nasal barbels. The resemblance between *Octonema* and *Elxis* (*Nemachilus obesus*) has already been pointed out above. If one compares the figures in Weber and Beaufort's book of *Glaniopsis* (p. 6) and of *Elxis* (p. 35) it becomes clear that as regards general facies and horizontal position of the paired fins the latter genus might with more justification be included in the Homalopteridae than *Glaniopsis*. In my opinion *Glaniopsis* should be placed in the Cobitidae among the *Nemachilus*-group (without suborbital spine), but distinguished from the remaining genera by the presence of 5 pairs of well-developed barbels.

In the present state of our knowledge the relationships of the Homalopteridae are rather obscure. It is common knowledge that when dealing with forms especially adapted to a particular environment it is very difficult to distinguish homologous from analogous characters and there is always a probability that fishes coming from an absolutely different stock have been similarly modified in response to a particular environment. By the earlier ichthyologists, however, the Homalopteridae were placed between the Cyprinidae and the Cobitidae, and were usually considered to form a connecting link between the two families. For instance, Bleeker (1863, p. 15) remarked, " Les Homaloptéroïdes sont, quant à leurs affinités, intermédiaires entre les Cobitioïdes et les Cyprinoïdes. Outre les caractères cités, ils diffèrent constamment des Cobitioïdes par la forme déprimée du corps et de la tête, et par la position et la forme des nageoires pectorales et ventrales, tandis que l'absence de vessie natatoire s'ajoute aux caractères constants par lesquels ils se distinguent des varais Cyprinoïdes" From a study of the Homalopteridae of the Indian Empire I (1920, p. 214) concluded that " the evolution of the Homalopteridae has occurred along the line of the Cobitidae of which we may take *Nemachilus* as a central genus" From a study of the skeletal characters, however, Regan (1929) finds that the Homalopteridae are widely different from the Cobitidae. From a comparison of Regan's descriptions of the two families (1911, pp. 30, 31) I have found the following differences. In Cobitidae the subtemporal fossae are shallow and there is a lateral occipital foramen on each side of foramen magnum, the cleithra are normally suspended from the supracleithra, the praeorbitals are unossified, and the anterior wall of the lateral expansion of air-bladder capsule is formed only by the transverse process of the second vertebra. In the Homalopteridae, on the other hand, the subtemporal fossae are deep and the lateral occipital foramina are absent, the cleithra are directly attached to the epiotics and are expanded to form horizontal laminae, the praeorbitals are large and

[1] Attention may be directed here to Weber and Beaufort's account of *G. hanitshi*. According to them there are 2 simple rays in the ventral fin, but, in the 2 typical specimens, I have been able to find only one.

extend forwards to the end of the snout and the air-bladder capsule is formed by the os suspensorium and the transverse process of the second vertebra. In comparing the skeletal features of these families it has to be borne in mind that the Cobitidae are laterally compressed or subcyclindrical fishes, whereas the Homalopteridae are feebly or greatly depressed and flattened. In the collection of skeletons in the British Museum the Cobitidae are represented by *Cobitis*, *Acanthopsis*, *Misgurnus* and *Botia*, all of which are sluggish water forms and possess a compressed body-form. The Homalopteridae are represented in the same collection by *Homaloptera*, *Balitora* and *Gastromyzon*, the last two of which are greatly depressed and are inhabitants of tumultuous currents of the torrents. Regan's descriptions are undoubtedly based on these skeletons, and the differences he has found between the two families become clear when the habitats and the body-forms of the genera studied are borne in mind. I have studied and compared these skeletons with the following results :—

In *Acanthopsis*, *Misgurnus* and *Cobitis* the sub-temporal fossae are very shallow and hardly recognisable ; in *Botia* they are shallow but well-defined ; in *Gastromyzon* they are

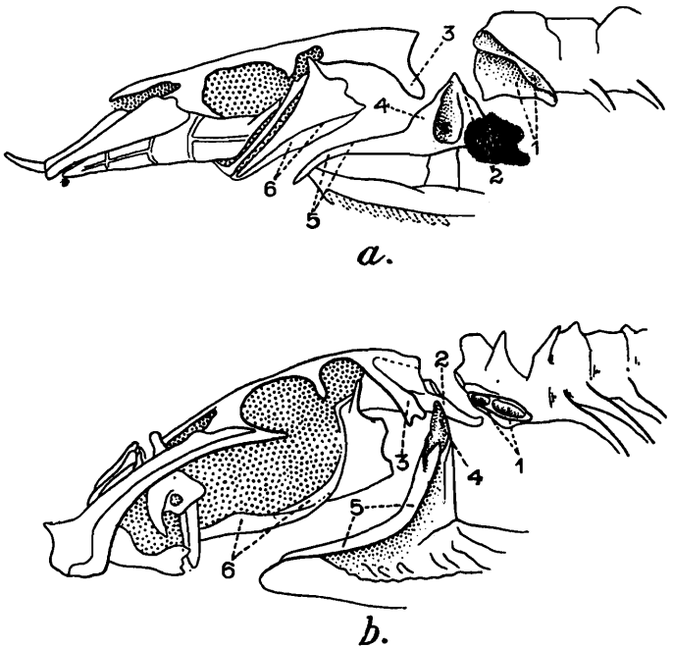


TEXT-FIG. 1.—Ventral view of the posterior part of skull of *Balitora* and *Gastromyzon*. ×4.
a. Balitora brucei Gray ; *b. Gastromyzon borneensis* Günther.

1. basioccipital.
2. exoccipital.
3. subtemporal fossa.
4. process of epiotic.
5. parasphenoid.
6. pharyngeal process of basioccipital.
7. pterotic.
8. pro-otic.

hardly recognisable, whereas in *Homaloptera* and *Balitora* they are fairly deep and are very much like those found in the Cyprinidae. The lateral occipital foramina are present in the 5 skeletons of the Cobitidae examined, whereas they are absent in the 3 skeletons of the Homalopteridae. Probably the absence of the lateral occipital foramina is due to the depressed condition of the skull in the Homalopteridae, which, in other respects as well, is more compact and solid.

In the Cobitidae the pectoral girdle is normally suspended from the skull, whereas in the Homalopteridae the arrangement is different, due partly to the greatly depressed form of the body and partly to the position, form and function of the fins. In the Homalopteridae the cleithrum is suspended from the skull through the intermediation of the epi-otic which is produced into a long process, but it is also attached to the transverse process of the second vertebra and to the opercular bones. In *Gastromyzon*[1] the transverse process of the second vertebra is rectangular and plate-like, and is directed outwards at right angle to the main axis of the vertebral column. The flattened surface is obliquely directed dorso-ventrally. Along the anterior face near the tip of the process is a facet for the attachment of the upwardly directed extremity of the cleithrum. Immediately below this end the cleithrum possesses an articular surface for the epi-otic process. Besides these two attachments the cleithrum is further supported by the opercular bones, especially the suboperculum which rests along the outer margin of the anterior face of the cleithrum.



TEXT-FIG. 2.—Diagrammatic representation of the mode of suspension of pectoral girdle in *Balitora* and *Gastromyzon*. ×3.
a. Balitora brucei Gray ; *b. Gastromyzon borneensis* Günther.

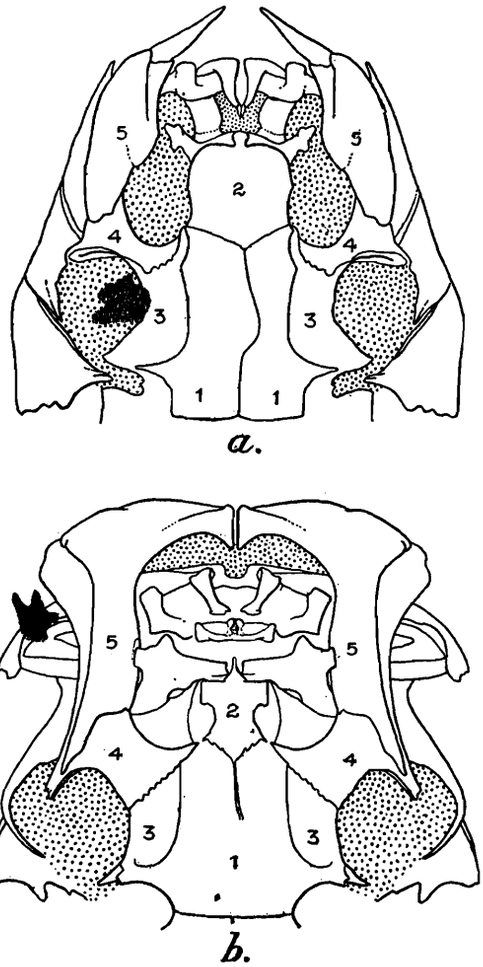
1. Transverse process of 2nd vertebra.
2. Area of attachment of cleithrum with transverse process of 2nd vertebra.
3. Process of the epi-otic bone.
4. Area of attachment of cleithrum with epi-otic process (3).
5. Area of attachment of cleithrum with opercular bones.
6. Opercular bones which support cleithrum.

In the case of *Balitora* the structures involved in the suspension of the cleithrum are the same as in *Gastromyzon*, though the arrangement is somewhat different. In *Balitora* the transverse process of the second vertebra is more massive, triangular and directed outwards at right angle to the vertebral column. Along its anterio-superior border there is an obliquely extended facet into which the posterior border of the cleithrum fits. At the base of the vertical portion of the cleithrum along the anterior surface is a well-marked articular surface for the attachment of the epi-otic process. The subopercular bone has an articular surface at the anterior end of the lateral border of the cleithrum.

[1] The skeletal features described here were studied from freshly prepared skeletons of *Gastromyzon* and *Balitora*.

The expanded condition of the cleithra to form horizontal lamellae is due partly to the horizontal position of the pectoral fins and partly to the necessity for a greater area for the attachment of muscles that move these fins. It has been pointed out above (p. 266) that the paired fins serve as organs of attachment and it is by the alternate movement of these fins that the fish are capable of crawling on wet, smooth rocks in very swift currents. I shall deal with the bionomics and modification of these organs later (p. 323).

In the three skeletons of the Homalopteridae the preorbital bones show progressive modification. In *Homaloptera* (*Helgia*-type) the preorbitals are essentially of the same type as found in the Cobitidae though of a somewhat larger size. In *Balitora* they are broad



TEXT-FIG. 3.—Dorsal view of the anterior part of skull of *Balitora* and *Gastromyzon*. ×4.
a. Balitora brucei Gray ; *b. Gastromyzon borneensis* Günther.
1. frontals.
2. supra-ethmoid.
3. postfrontals.
4. prefrontals.
5. preorbitals.
The terms post- and pre-frontal are used after Günther (*The Study of Fishes*, p. 57, 1880).

and expanded and extend forwards for a considerable distance. At their anterior ends they are joined by small wedge-shaped bones which extend to the end of the snout. In *Gastromyzon* the preorbital is a long and massive bone, curving inwards at the anterior end to meet its fellow of the opposite side in the middle line ; thus a bony arch is formed anteriorly to support the end of the snout. All hill-stream fishes, so far as my knowledge goes, adhere to rocks with the head pointing up-stream. Consequently, the snout is the

part of the fish against which water strikes with considerable impact. The modifications of the preorbital bones noted above are, in my opinion, produced to resist this impact by providing strength and solidity to the anterior end of the fish.

Unfortunately, sufficient material of the various genera of the Homalopteridae does not exist at present to study from a comparative point of view the skeletal modifications undergone by the members of this family, but I have endeavoured to show that some of the special skeletal features of this family are mere masks superimposed on it by the environmental conditions. Such characters, instead of helping in the elucidation of affinities, tend to obscure them.

I (1930, p. 267 ; 1930*a*, p. 583 ; 1931, p. 67) have pointed out more than once that the so-called simple rays in the paired fins of the Homalopteridae are of two different kinds. In *Balitora*, for example, the simple rays are produced by the coalescence of the branches of an ordinary ray, whereas in *Gastromyzon* there is only one true simple ray, the neighbouring rays, although appearing simple superficially, being in reality forked. In this last case the primary branching is retained and each of these branches is then modified into a simple ray. On the morphological structure of these rays the Homalopterid fishes have been grouped by me (1930, p. 67) in two subfamilies—Homalopterinae and Gastromyzoninae.[1] The former is characterised by the presence of *two or more* undivided rays in the paired fins, whereas the latter possesses only *one* such ray. Fang (1930*a*, pp. 41, 42) has found that the basipterygium of *Sinogastromyzon*, *Hemimyzon* and *Sinohomaloptera* (all belonging to the Homalopterinae) always possesses a lateral foramen, and that the modified rib is provided with a distally attached ligament to which the basipterygium is connected at the region of its lateral foramen. Moreover, the basipterygium is devoid of the lateral horn. I have found that the basipterygium of *Homaloptera* and *Balitora* (plate x, fig. 1), both of which belong to the Homalopterinae, is also of the nature described above. Fang has further found that in *Beaufortia* (=*Gastromyzon* of Fang ; *vide* page 318) and *Pseudogastromyzon*, belonging to the Gastromyzoninae, the basipterygium does not possess a lateral foramen, but is always provided with a lateral horn. Moreover, in these genera the modified rib possesses an inward process near its broadened end to which the ligament is attached. The other end of the ligament is attached to the lateral horn of the basipterygium. I have found that the basipterygium and the modified rib of *Gastromyzon borneensis* (plate x, fig. 2) are of a similar nature. It is quite probable that the skeletal features indicated above separate the Homalopterinae and the Gastromyzoninae, but no generalisation can be made until the skeletons of the remaining genera are also studied.

I have mentioned above that in *Homaloptera* and *Balitora* the subtemporal fossae are very deep ; whereas in *Gastromyzon* they are hardly recognisable. If future researches show that the subtemporal fossae are deep in the other genera of the Homalopterinae also, and that they are shallow in those of the Gastromyzoninae, this character will be of special importance in discussing the affinities of the family. The subtemporal fossae are very deep in the Cyprinidae. This would indicate the close relationship of the Homalopterinae and the Cyprinidae, and it would then be reasonable to assume that the former have evolved

[1] I am retaining the names Homalopterinae and Gastromyzoninae originally proposed by Fowler (*Proc. Acat. Nat. Sci. Philad.* (2) LVII, pp. 475, 477 ; 1905), though my characterisation of the two subfamilies is absolutely different from that given by him.

from some Cyprinid ancestors. Such a view is greatly strengthened by the fact that both Psilorhynchidae and Homalopterinae possess a number of simple rays in the paired fins. *Gastromyzon* and its allies, which probably possess shallow subtemporal fossae, would then appear to have been evolved from the Cobitidae, which are characterised by the possession of shallow subtemporal fossae. The Homalopteridae are probably a polyphyletic family and it is likely that its members are derived from the Cyprinidae and the Cobitidae and have come to resemble one another superficially under similar conditions of environment.

The two subfamilies of the Homalopteridae can be distinguished by the following key :—

A. Two or more undivided, anterior rays in the paired fins (subtemporal fossae deep ; basipterygium with a lateral foramen and devoid of lateral horn ; a ligament connecting distal end of modified rib and region of lateral foramen of basipterygium) — *Homalopterinae.*

B. Only one undivided, anterior ray in the paired fins (subtemporal fossae shallow ; basipterygium without a lateral foramen and with a lateral horn ; a ligament connecting a medial process of modified rib with lateral horn of basipterygium) — *Gastromyzoninae.*

Subfamily HOMALOPTERINAE.

The subfamily Homalopterinae is characterised by the possession of *two or more* undivided anterior rays in the paired fins.

[The subtemporal fossae are deep ; the basipterygium is provided with a lateral foramen and is devoid of a lateral horn and there is a ligament connecting the distal end of the modified rib and the region of the lateral foramen of the basipterygium.]

In the present state of our knowledge six genera can be recognised in this subfamily. These may be distinguished by the following key :—

I. Two anterior rays of ventral fin simple.

A. Rostral groove in front of mouth absent ; rostral fold absent or very slightly developed ; lips simple, without papillae — *Homaloptera*, p. 274.

B. Deep rostral groove in front of mouth present ; rostral fold present ; lips, especially the upper, strongly papillated or fimbriated.

1. Two barbels at each angle of mouth ; 7-8 anterior rays of pectoral simple ; body moderately depressed and considerably elevated ; snout pointed — *Sinohomaloptera*, p. 288.

2. One barbel at each angle of mouth ; 9-10 anterior rays of pectoral simple ; body greatly depressed and flattened ; snout rounded and trenchant — *Balitora*, p. 290.

II. Three or more anterior rays of ventral fin simple.

A. Ventrals free from each other, not united to form a disc-like structure.

1. Tail long and slender ; least height of caudal peduncle less than diameter of eye ; fimbriated lips ; 3 barbels at each angle of mouth — *Lepturichthys*, p. 292.

2. Tail more solid and deep ; least height of caudal peduncle greater than diameter of eye ; papillated lips ; 2 barbels at each angle of mouth — *Hemimyzon*, p. 298.

B. Ventrals united posteriorly to form a disc-like structure — *Sinogastromyzon*, p. 302.

There can hardly be any doubt that among the Homalopterinae the genus *Homaloptera*, which is represented by as many as 19 species from Java, Sumatra, Borneo, Federated Malay States, Siam, Burma and South India, is of a generalised nature, and that it formed a starting point for the differentiation and ultimate evolution of the other genera in the subfamily. *Homaloptera*, as defined here, is an assemblage of heterogenous forms, some of which differ widely from one another, but the differences between them are bridged over by intermediate forms. All the species of *Homaloptera*, however, possess a subterminal mouth and plain, simple lips. It is conceivable that with the increasing specialisation for life in rapid-flowing waters the mouth shifted backwards, and, consequently, by a rolling of the skin over the snout to the ventral surface the rostral fold was formed much in the same way as has been explained by me (1921, pp. 639-643) in the case of some other hill-stream fishes. To the various adaptations for respiration (p. 325), while the fish lies closely applied to the substratum, and to the peculiar habit of feeding by scraping off algal slime from the rocks (p. 327), can be traced the development and evolution of the rostral groove, the rostral barbels and the papillated and fimbriated nature of the lips. It is probable that some of the narrow and long-snouted species of *Homaloptera* (plate x, fig. 3)—*Helgia*-like forms—gave rise to *Sinohomaloptera* ; whereas the depressed and flattened forms of the same stock—*Bhavania*-like species of *Homaloptera* (plate x, fig. 4)—gave rise to *Balitora*. The genus *Hemimyzon*, as recognised here, seems to have been evolved along parallel lines from *Balitora* and from *Sinohomaloptera*. The species like *H. formosanum* and *H. sinensis* are probably derived from *Balitora*-like ancestors ; whereas species like *H. yaotanensis* and *H. acuticauda* seem to have been evolved from *Sinohomaloptera*-like ancestors. *Sinohomaloptera* seems also to have given rise to *Lepturichthys*, a genus closely allied to *Sinohomaloptera* but differing from it by its long, slender tail and fimbriated lips. *Sinogastromyzon* is the most specialised genus of the subfamily, and appears to have been derived from the broad-headed species of *Hemimyzon*. Thus, it seems probable that the *Bhavania*-like species of *Homaloptera*, through *Balitora* and broad-headed species of *Hemimyzon*, gave rise to *Sinogastromyzon*. It has been indicated above (p. 272) that this subfamily has probably evolved from the Cyprinidae.

Homaloptera van Hasselt *emend.* van der Hoeven.

(Plate X, figs. 3, 4, 5 ; Plate XI, figs. 1, 2, 3, 4.)

1823. *Homaloptera*, van Hasselt, *Algem. Konst.-en Letterbode* II, p. 130.
1833. *Homaloptera*, van der Hoeven, *Handboek der Dierkunde*, 1st ed., II, p. 211.
1846. *Balitora*, Cuvier & Valenciennes (in part), *Hist. Nat. Poiss.* XVIII, p. 91.
1860. *Homaloptera*, Bleeker, *Ichth. Arch. Ind. Prodr.* II, Cyprini, p. 86.
1860. *Homaloptera*, Blyth, *Journ. Asiat. Soc. Bengal* XXIX, p. 172.
1863. *Homaloptera*, Bleeker, *Atl. Ichthyol.* III, p. 16.
1868. *Homaloptera*, Günther (in part), *Cat. Fish., Brit. Mus.* VII, p. 340.
1877. *Homaloptera*, Day (in part), *Fish. India*, p. 525.
1889. *Homaloptera*, Day (in part), *Faun. Brit. Ind. Fish.* I, p. 242.
1890. *Helgia*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* XXIX, p. 200.
1905. *Homalopteroides*, Fowler, *Proc. Acad. Nat. Sci. Philad.* (2) LVII, p. 476.
1916. *Homaloptera*, Weber & Beaufort, *Fish. Indo-Austral. Archipel.* III, p. 6.
1920. *Bhavania*, Hora, *Rec. Ind. Mus.* XIX, p. 202.
1929. *Chopraia*, Prashad & Mukerji, *Rec. Ind. Mus.* XXXI, p. 188.

The head and the anterior part of the body are feebly or moderately depressed and the ventral surface is flattened. The body is usually subcylindrical and the fishes resemble loaches of the genus *Nemachilus*. The snout is either broad and rounded (*Bhavania*-like form, plate x, fig. 4) or it is long and pointed (*Helgia*-like form, plate x, fig. 3). The mouth is inferior, transverse, slightly arched and of moderate size. The lips are full, plain and continuous. There are 4 rostral barbels and one at each angle of the mouth. The jaws are strong and provided with sharp, rasping edges. The gill-opening is oblique and extends to the ventral surface for a short distance in front of the base of the pectoral fin. The eyes are superior or dorsolateral and are provided with free orbital margins ; they are not visible from the ventral surface. The body is covered with small or moderate-sized scales, which are absent on the head. The flattened ventral surface of the body is sometimes partly or wholly naked. The paired fins are broad and horizontal. The pectoral possesses 14 to 20 rays, of which 4 to 8 outer rays are simple. The ventral is provided with 8 to 10 rays, of which 2 outer rays are simple. The caudal peduncle is usually long and narrow and the caudal fin is either emarginate or deeply forked, with the lower lobe longer than the upper. The dorsal fin commences in advance of, opposite to, or slightly behind the ventrals.

Type.—Homaloptera ocellata van der Hoeven.

Great confusion prevails regarding the taxonomy of the fishes assigned to the genus *Homaloptera* and for a long time the genus acted as a lumber room for the accommodation of Homalopterid species of diverse affinities. In recent years several species have been taken out of this genus and rightly made the types of new genera ; but a great deal remains still to be done. The points to be considered here are, firstly, the author or authors to whom the genus should be assigned ; secondly, to fix a type-species for the genus ; and lastly, to discuss the specific validity and probable relationships of the various species that are still included in the genus.

Homaloptera was proposed by van Hasselt in 1823, and was characterised as follows : " Het genus *Homaloptera* Mihi, onderscheidt zich hoofdzakelijk door de horizontale plaatsing der borsten buikvinnen, waardoor hetzelve eenigzins den vorm der Rhinobaten ontrangt. De specien Javanica en fasciata Mihi Tab., noemt de Zundanees Toeloesoer."[1] This description is of a generalised type applicable to all the Homalopterid fishes and several other species that live in torrents. Unfortunately, van Hasselt neither gave a description of his species nor were any drawings published of them, although it is clear from the above that illustrations[2] were made of *H. javanica* and *H. fasciata*. In these circumstances the two specific names are not valid. From a perusal of the literature it is observed that van Hasselt collected two more species of his genus *Homaloptera* in Java and sent the specimens, probably accompanied by figures, to the Leiden Museum under the names *H. ocellata* and *H. erythrorhina*.

There can hardly be any doubt that van der Hoeven based his characterisation of *Homaloptera* on the material of the 4 species of van Hasselt in the Leiden Museum. His

[1] A free translation of this in English is as follows :—" The genus *Homaloptera* Mihi, is principally distinguished by the horizontal position of the pectoral and ventral fins, through which it gets somewhat the form of the Rhinobates. The species *Javania* and *fasciata* Mihi Tab. ; the Sundanese call them Toeloesoer."

[2] During my visit to Leiden I made special efforts to find out the manuscript and figures of the Javanese fishes by Kuhl and van Hasselt, but unfortunately without any success. No person at the Museum knew anything about these manuscripts and they were not to be found in any of the libraries likely to possess them. Specimens of " *Homaloptera javanica*," " *H. fasciata* " and *H. ocellata* from Kuhl and van Hasselt's collection were examined in the Zoological Museum at Leiden.

definition of the genus is somewhat more comprehensive and runs as follows : " *Homaloptera* van Hass. Corpus elongatum, squamis parvis tectum. Caput parvum, nudum, ore infero, parvo, edentulo, cirris 6. Oculi parvi in superiori capitis parte siti. Membrana branchiostega radiis 3. Pinnae pectorales magnae, complanatae. Pinna dorsalis supra ventrales posita." To illustrate this genus van der Hoeven gave a poor figure[1] of *Homaloptera ocellata* with the following meagre description :—" Sp. *Homaloptera ocellata,*[2] eene nieuwe soort van Java. Det geslacht staat, zoo als het schijnt, tusschen *Cobitis* en *Cyprinus* in het midden. De staartvin is gevorkt, en niet afgeknot, zoo als bij *Cobitis.*" Though the above description is meagre and inadequate and the figure faulty and poor, this is the first species described and figured under the genus *Homaloptera* and should, therefore, be considered as the type of the genus. Moreover, this is one of the species which the author of the genus had referred to *Homaloptera.* From the above it is clear that the authors of the genus may be designated as : *Homaloptera* van Hasselt *emend.* van der Hoeven. Further, it is clear that though the specific names *javanica* and *fasciata* were in print before *ocellata,* they were not accompanied by any description or figure. Consequently, *H. ocellata* van der Hoeven (Ms. van Hasselt) becomes the type of the genus (plate x, fig. 5).

Cuvier and Valenciennes did not recognise the name *Homaloptera* and in their chapter dealing with the " Balitores " remarked as follows : " Le genre nouveau de poisson, dont il va être traité dans ce chapitre, a été découvert dans les eaux douces de Java par MM. Kuhl et Van Hasselt. Ces infatigables zoologistes avaient reconnu les caractères particuliers de ces cyprinoïdes, et ils avaient envoyé trois espèces accompagnées de dessins élégans faits d'après nature. Le nom qu'ils avaient imaginé n'a pas été imprimé. Ils auraient appelé leur nouveau genre *Homaloptera.*" It is abundantly clear from the above discussion that the name *Homaloptera* was rejected by Cuvier and Valenciennes under a misapprehension. Moreover, the name *Balitora* of Gray, used by them for " the three species " of Kuhl and van Hasselt, refers to a very distinct genus from India and Burma (p. 290). The three species, to which a reference is made by Cuvier and Valenciennes, are *Balitora erythrorhina, Balitora ocellata* and *Balitora pavonina.* I have examined the type-specimens of these species in the Muséum National d'Histoire Naturelle, Paris, with the following interesting results. *Balitora ocellata* is in reality *Homaloptera wassinki* Bleeker (=*H. fasciata* van Hasselt) ; whereas the other two species are referable to *H. ocellata* van der Hoeven, *H. erythrorhina* being based on adult specimens with characteristic colouration. It seems quite probable that specimens and labels must have got mixed up when the material was sent from Leiden to Paris. Kuhl and van Hasselt's material now preserved in the Leiden Museum is correctly labelled.

Blyth (*op. cit.*) was the first to indicate that *Balitora* of Gray is distinct from *Homaloptera,* of which he said, " a form intermediate to the ordinary spineless loaches and *Balitora* of Gray." Bleeker, Günther and Day accepted the name *Homaloptera* but included *Balitora* in it as a synonym. It is Bleeker, however, who gave a clear definition of the genus and raised it to the rank of a subfamily. He erroneously included in the subfamily the then

[1] Van der Hoeven's figure of *H. ocellata* appears to have been made from a badly preserved specimen. In the illustrations no attempt is made to show the characteristic colouration of the species. The dorsal surface of the head and the nature and position of the paired fins are clearly delineated.

[2] Van der Hoeven assigns the authorship of the species to van Hasselt in the description of plates, showing thereby that the specimens were sent by van Hasselt to Leiden under this name.

little-known genus *Psilorhynchus*. Vinciguerra (*op. cit.*) fully realised the difference between *Balitora* and *Homaloptera*, but unfortunately he used the name *Homaloptera* for *Balitora* and proposed a new name *Helgia* for the two species of *Homaloptera*. My genus *Bhavania* was characterised by a broad and rounded head approaching that of *Balitora*, but now I find that among species of *Homaloptera* there are all stages between the *Helgia*-like form and the *Bhavania*-like facies. I have thought it advisable, therefore, to treat *Bhavania* as a synonym of *Homaloptera*.

Prashad and Mukerji established the genus *Chopraia* for a small species from Upper Burma. They pointed out that their genus was "very closely allied to *Homaloptera*," and differed "from the other genera of the family in the general form, the shape of the head, the situation and better development of the eyes, the branchial openings and the fins." After an examination of a large material of the genus *Homaloptera* I find that "*Chopraia rupicola*" is congeneric with such forms as *Homaloptera wassinki*, *H. modesta*, *H. weberi*, etc., all of which possess large and dorso-lateral eyes, large and slightly pedunculate pectorals which extend slightly beyond the commencement of the ventrals and in which the dorsal fin begins considerably behind the commencement of ventrals. Moreover, all gradations exist between such forms and the species in which the head is narrow and pointed, the eyes are small and the pectoral fins are not very large. I am, therefore, unable to recognise *Chopraia* as a genus distinct from *Homaloptera*.

The large-eyed forms of *Homaloptera* resemble superficially the young specimens of *Psilorhynchus*. It is also worthy of remark that the air-bladder of *H. rupicola* consists of two large lateral chambers, which are enclosed in thin bony capsules, and of a narrow, transverse connecting tube. Such a structure is different from the greatly reduced air-bladder of highly modified Homalopterid fishes, *Balitora* (Hora, 1920) for example. It would seem more probable, therefore, that the forms like *H. rupicola* represent the less specialised members of the genus *Homaloptera*.

The taxonomy of the various species of *Homaloptera* is very confused, but it is now possible to define the specific limits of the older species in the light of the material examined in the various museums of Europe.

Homaloptera ocellata van der Hoeven.

(Plate X, fig. 5.)

1833. *Homaloptera ocellata*, van der Hoeven, *Handboek Dierkunde*, 1st ed., II, p. 211.
1846. *Balitora erythrorhina*, Cuvier & Valenciennes, *Hist. Nat. Poiss.* XVIII, p. 93.
1846. *Balitora pavonina*, Cuvier & Valenciennes, *ibid.*, p. 97.
1853. *Homaloptera polylepis*, Bleeker, *Nat. Tijdschr. Ned. Indië* IV, p. 162.
1860. *Homaloptera ocellata*, Bleeker, *Ichth. Arch. Ind. Prodr.* II, Cyprini, p. 92.
1860. *Homaloptera pavonina*, Bleeker, *ibid.*, p. 92.
1863. *Homaloptera ocellata*, Bleeker, *Atl. Ichth.* III, p. 18.
1863. *Homaloptera pavonina*, Bleeker, *ibid.*, p. 18.
1868. *Homaloptera pavonina*, Günther, *Cat. Fish. Brit. Mus.* VII, p. 341.
1894. *Homaloptera pavonina*, Weber, *Zool. Ergebnisse Reise Nied. Ost-Indien* II, p. 424.
1916. *Homaloptera erythrorhina*, Weber & Beaufort (in part), *Fish. Indo-Austral. Archipel.* III, p. 17.
1916. *Homaloptera pavonina*, Weber & Beaufort, *ibid.*, p. 18.

Weber and Beaufort did not recognise the name *ocellata* of van der Hoeven, as in their opinion it was not accompanied by any description. It has been shown above (p. 276) that van der Hoeven gave a brief description of the species and published a figure of it. Thus, under Article 25 of the International Rules of Zoological Nomenclature, this specific name is quite valid. Cuvier and Valenciennes's *Homaloptera ocellata* has to be rejected, apart from other considerations (p. 276), as a homonym (Article 35).

There are 3 specimens of *H. erythrorhina* in the Paris Museum from the collection of Kuhl and van Hasselt. The largest specimen, 135 mm. in total length, is probably the original of the figure by Valenciennes. Except that the colour pattern of the specimen is slightly different, in all other respects it corresponds closely to the typical specimens of *ocellata* examined by me in the Museums at Leiden and Amsterdam. A large specimen, about 142 mm. in total length, in the Amsterdam Museum is labelled as *H. erythrorhina*. This is very much like the type of the species in the Paris Museum.

I took this specimen to Leiden and compared it with the type of *H. ocellata*, and found that the two species cannot be recognised as distinct.

The type-specimen of *H. pavonina* is in the Paris Museum (No. 3123). It is partly desiccated and the skin and flesh are shrivelled up. Consequently, the bones of the head are more prominent and the fish appears to have a narrow and long snout. The specimen is eviscerated. On account of the shrunken condition of the other parts of the head the eyes are very prominent and appear to be large. There is a black band below the eye which is a characteristic feature of *H. erythrorhina* also. The similarity between these two species is still more marked when the young specimens of *H. erythrorhina* in the Paris Museum are compared with the type-specimen of *H. pavonina*.

There are two large specimens in the British Museum under the name *H. pavonina*. They were purchased from Bleeker, who had named them *H. ocellata*, as is clear from the old labels.

Weber and Beaufort distinguished *H. pavonina* and *H. erythrorhina* by the proportionate depth of their bodies and the length of the "longest rays of pectorals" In the type-specimen of *H. pavonina* I did not find any ray of the pectoral fin longer than the head. In fact, with regard to the pectorals the two species agree very closely. The difference in the proportionate depth of the body is probably due to the condition of the specimens, as I have indicated above.

The type-specimen of *H. ocellata* is in the Leiden Museum (No. 2723) ; it was collected by Kuhl and van Hasselt in Java and probably served for the description and figure of van der Hoeven. Besides this there are 13 other specimens (No. 7049) in the Leiden Museum under the name *H. ocellata* from Bleeker's collection. The largest specimen in this series corresponds with the type, whereas in the young examples the snout is more pointed and the ventrals extend beyond the anal opening. Two similar specimens from Bleeker's collection are present in the Museum at Amsterdam.

From an examination of the large number of specimens including types of *H. ocellata*, *H. erythrorhina* and *H. pavonina* I am convinced that the three names refer to the same species. It seems probable that variations in colouration or in the height of the body due to the sex of the specimens led the earlier ichthyologists to give these names to the same

species. It is, however, significant that Günther considered these three names as synonymous.

Weber and Beaufort have included *H. salusur* Bleeker in the synonymy of *H. erythrorhina*. I have examined 6 specimens of this species from Bleeker's collection in the Leiden Museum and found them quite distinct from *H. ocellata*. In *H. salusur* the scales are smooth without any trace of keels, the snout is long and pointed (*Helgia*-like) and the ventrals extend beyond the anal-opening.

There is a specimen of *H. salusur* from Bleeker's collection in the British Museum. It is probably a female specimen full of eggs and consequently the abdomen is greatly distended, and the ventrals do not reach the anal-opening. With regard to the form of the snout and the character of the scales it corresponds with the examples in the Leiden Museum.

Homaloptera wassinki Bleeker.

1823. *Homaloptera fasciata*, van Hasselt, *Algem. Konst-en Letterbode* II, p. 130 (name only, no description or figure).
1846. *Balitora ocellata*, Cuvier & Valenciennes, *Hist. Nat. Poiss.* XVIII, p. 96 (*nec* van der Hoeven, see p. 277).
1853. *Homaloptera wassinkii*, Bleeker, *Nat. Tijdschr. Ned. Indië* IV, p. 163.
1860. *Homaloptera Valenciennesi*, Bleeker, *Ichth. Arch. Ind. Prodr.* II, Cyprini, p. 95.
1860. *Homaloptera fasciata*, Bleeker, *ibid.*, p. 96.
1863. *Homaloptera Valenciennesi*, Bleeker, *Atl. Ichth.* III, p. 19.
1863. *Homaloptera fasciata*, *ibid.*, p. 20.
1868. *Homaloptera wassinkii*, Günther, *Cat. Fish Brit. Mus.* VII, p. 342.
1894. *Homaloptera* (*Helgia*) *modesta*, Boulenger (in part, *nec* Vinciguerra), *Ann. Mag. Nat. Hist.* (6) XIII, p. 251.
1902. *Homaloptera wassinkii*, Vaillant, *Notes Leyden Mus.* XXIV, p. 31.
1905. *Homalopteroides wassinkii*, Fowler, *Proc. Acad. Nat. Sci. Philad.* (2) LVII, p. 476.
1916. *Homaloptera wassinki*, Weber & Beaufort (in part), *Fish. Indo-Austral. Archipel.* III, p. 9.
1916. *Homaloptera ocellata*, Weber & Beaufort (*nec* van der Hoeven), *ibid.*, p. 10.

It has been pointed out by Weber and Beaufort that *Homaloptera ocellata* of Cuvier and Valenciennes " is nearest to *H. wassinki*, but differs from it by minor height, larger eyes, by the position of the dorsal and by the caudal which is only slightly emarginate " They remarked further that as " *H. ocellata* is founded on a single specimen, we think it possible, that *H. ocellata* and *H. wassinki* belong to one and the same species ". I have studied the type-specimen of " *Balitora ocellata* " in the Paris Museum (No. 3122), and am fully convinced that it is referable to *Homaloptera wassinki* [*H. ocellata* (C. and V.) is to be rejected as a homonym]. The characters in which it is said to differ from *H. wassinki* are not of specific value, but are due to individual variation. The type-specimen is from Kuhl and van Hasselt's collection and it seems highly probable that, owing to wrong labelling at Leiden, it was sent to Cuvier and Valenciennes as *H. ocellata* instead of as *H. fasciata*.

In the British Museum there is a typical specimen of *H. wassinki* (the old label shows it as *H. fasciata*) from Bleeker's collection. Besides, there are other specimens, of which 3 (No. 93.3.6.258-60) from Senah, Sarawak, and 6 (92.9.2.73-8) from Tagora R., Sarawak, were wrongly identified by Boulenger as *Helgia modesta*.

In the Leiden Museum there are several specimens of *H. wassinki* fro m Bleeker's collection labelled as *H. fasciata.* There are 2 fine examples in the Amsterdam Museum collected by Prof. Max Weber in 1888. Two young specimens from Kuala Lumpur (Malay Peninsula) in the Amsterdam Museum are labelled as *H. wassinki.* They are *Helgia*-like in appearance and are provided with large eyes. The head is long and narrow and the body is considerably elevated. The pectorals extend beyond the commencement of the ventrals. It is very difficult to be certain of the determination of these specimens.

Homaloptera zollingeri Bleeker.

1823. *Homaloptera Javanica,* van Hasselt, *Algem. Konst-en Letterbode* II, p. 130 (name only, no description or figure).
1853. *Homaloptera Zollingeri,* Bleeker, *Nat. Tijdschr. Ned. Indië* IV, p. 159.
1860. *Homaloptera javanica,* Bleeker, *Ichth. Arch. Ind. Prodr.* II, Cyprini, p. 89.
1863. *Homaloptera javanica,* Bleeker, *Atl. Ichth.* III, p. 17.
1868. *Homaloptera zollingeri,* Günther, *Cat. Fish. Brit. Mus.* VII, p. 342.
1916. *Homaloptera zollingeri,* Weber & Beaufort, *Fish. Indo-Austral. Archipel.* III, p. 14.

Of *Homaloptera zollingeri* I have examined 3 specimens in the Leiden Museum from Bleeker's collection and labelled as *H. javanica.* A specimen from Bleeker's collection is also present in the British Museum, which contains a second specimen of the species from Siam (Upper Bangpakong River). The chief distinguishing feature of the species is the forward position of the anal-opening, so that the ventrals extend considerably beyond it. The scales are strongly keeled and the snout is broad, rounded and spatulate. The lower lobe of the caudal fin is longer than the upper.

Homaloptera gymnogaster Bleeker.

1853. *Homaloptera gymnogaster,* Bleeker, *Nat. Tijdschr. Ned. Ind.* IV, p. 163.
1860. *Homaloptera gymnogaster,* Bleeker, *Ichth. Arch. Ind. Prodr.* II, Cyprini, p. 98.
1863. *Homaloptera gymnogaster,* Bleeker, *Atl. Ichth.* III, p. 20.
1868. *Homaloptera gymnogaster,* Günther, *Cat. Fish. Brit. Mus.* VII, p. 341.
1916. *Homaloptera gymnogaster,* Weber & Beaufort, *Fish. Indo-Austral. Archipel.* III, p. 11.
1916. *Homaloptera lepidogaster,* Weber & Beaufort, *ibid.,* p. 14.

Weber and Beaufort described *Homaloptera lepidogaster* from three specimens in the Amsterdam Museum and characterized it among the "*Homalopteroides*" as having the "abdomen totally scaly" In the description of the species they remark, "posterior half of abdomen and space between ventrals totally scaly" In the Amsterdam Museum I found 3 other specimens which undoubtedly belonged to *H. lepidogaster* and had been labelled as *H. gymnogaster* by Weber. Through the kindness of Prof. L. F. de Beaufort I obtained one of these specimens and have compared it with the type of *H. gymnogaster* in the British Museum. I am of opinion that *H. lepidogaster* is a synonym of *H. gymnogaster.* The latter species is provided with scales "between ventrals and in a triangular patch before them"; thus, as regards the lepidosis there is hardly any difference between the two species.

Bleeker's figure of the species is inaccurate so far as the form of the snout is concerned. It is not pointed as shown in the figure, but is broad and rounded.

The type-specimen of *H. gymnogaster* in the British Museum is in a very poor condition, and it is very difficult to ascertain the salient features of the species.

Of the 14 species of *Homaloptera* described by Weber and Beaufort in their book, there are 2 others that may be discussed here. *Homaloptera orthogoniata* Vaillant is very closely related to *H. bilineata* Blyth, not only in general facies but also with regard to the nature and number of the pharyngeal teeth. The colour pattern of the two species is different and very striking. Moreover, so far as I am aware, *H. bilineata* is a small species not growing to more than $2\frac{1}{2}$ inches in length.

H. orthogoniata is very much like *H. ocellata*, from which it differs in its characteristic colouration and in the fact that the whole of its ventral surface is covered with scales.

Homaloptera whiteheadi Vaillant does not belong to this genus, as it is provided with only one simple outer ray in its paired fins. In the Paris Museum I have examined 2 large and 5 young specimens of this species, but unfortunately all of them are so soft and flabby that I could not determine with any degree of accuracy the form of the mouth, lips, jaws and the other associated structures. The number of rays in the pectoral fins is very large and the general facies is like *Homaloptera*. I am, therefore, retaining this species among the Homalopteridae (p. 306) as a type of a new genus.

There is one other species described in the genus *Homaloptera* from Hainan to which I may refer here. This is *H. fasciolata* Nichols and Pope (1927, p. 339) which I know only from their inadequate description and very poor figure. From its general facies, the form and position of the pectoral fins and the nature of the barbels it seems to belong to the genus *Nemachilus*. Unfortunately, the authors do not give the number of rays in the paired fins nor it is known how many of these rays are simple. Herre and Myers (1931) have recently shown that this species does not belong to *Homaloptera*, they have placed it in the genus *Homatula* (=*Nemachilus*) among the Cobitidae.

Among the Homalopterid fishes that I have examined in the Zoological Museums of Europe I have found representatives of two new species of *Homaloptera* from Borneo which are described below. In the collection of the Homalopterid fishes sent to me for study by Dr. H. M. Smith from Siam there is another new species of *Homaloptera* which is also described here.

Homaloptera stephensoni, sp. nov.

(Plate XI, fig. 1.)

1906. *Helgia modesta*, Popta (*nec* Vinciguerra), *Notes Leyden Mus.* XXVII, p. 186.
1916. *Homaloptera wassinki*, Weber & Beaufort (in part), *Fish. Indo-Austral. Archipel.* III, p. 9.

D. 2/7 ; A. 2/5 ; P. 5/11 ; V. 2/8. L. l. 45. L. tr. 5/1/3.

Homaloptera stephensoni is a small and slender fish in which the ventral profile is straight and horizontal throughout and the dorsal profile is slightly arched. The head and the

anterior part of the body are feebly depressed and the ventral surface is broad and flattened. The head is short and pointed ; its length is contained 4·6 times in the total length without the caudal and 5·7 times with the caudal. The width of head in front of the bases of the pectorals is contained 1·2 times in its length and the height of head at the occiput is contained 1·7 times in its length. The snout is narrow and pointed and is about half the length of the head, consequently the eyes are situated in the posterior half of the head. The eyes are large, superior and provided with free orbital margins ; the diameter of the eye is contained 4·3 times in the length of the head, 2·2 times in the length of the snout and 1·2 times in the interorbital width. The nostrils are situated in front of the eyes ; the anterior nostril is slightly tubular. The greatest width of the body is in front of the ventrals, it is contained 6·3 times in the total length including caudal and 5·1 times without the caudal. The body is higher than the head ; the height of body is contained 8·7 times in total length including caudal and 7 times without the caudal. The caudal peduncle is long and slender ; its least height is contained 2·7 times in its length. The body is covered with moderately small scales which are absent on the head and the entire flattened ventral surface of the body as far as the anal-opening. The scales are almost smooth in the tail region, but are carinate anteriorly ; the keels are more marked on the scales above the pectoral fins. There are about 17 scales between the head and the origin of the dorsal fin.

The mouth is situated slightly behind the tip of the snout on the ventral surface ; it is small and slightly arched. The lips are full and do not cover the jaws ; the lower jaw is rounded and is provided with a sharp rasping edge. When the mouth is closed the lower jaw fits in the concavity of the upper jaw. There are 4 rostral barbels, the 2 inner being very minute. There is also a barbel at each angle of the mouth which is longer than the outer rostral barbel.

The dorsal and the anal fins are short ; the former commences behind the ventrals and its origin is much nearer the tip of the snout than the base of the caudal fin. The pectoral is slightly pedunculate, broad and fan-shaped ; it extends over the base of the ventral for a short distance. The ventrals are also extensive and are provided with convergent bases ; they just reach the anal-opening, which is situated at a considerable distance from the anal fin. The caudal fin is narrow and much longer than the head ; it is deeply forked with the two lobes sharply pointed, the lower lobe being longer than the upper. Some of the outer rays in the two lobes are fused together.

The colour in spirit is reddish brown on the dorsal surface and white on the ventral surface. There is a series of 5 rounded spots along the dorsal surface, the second from the front encircling the base of the dorsal fin. The posterior 3 spots are continued on the sides thus forming short, saddle-like bands. The sides of the body are irregularly mottled with blotches and the snout is marked with 2 pairs of longitudinal streaks radiating from the eye. The pectoral and the ventral fins are provided with 2 broad bands and their bases are of deep brown colour. The dorsal and the anal fins are provided with a band each in the middle of their lengths. The caudal fin is marked with two zig-zag bands.

Locality.—Upper Mahakam River, Borneo. The type-specimen (No. 7633) is in the Leiden Museum.

Measurements in millimetres.

Total length including caudal	61·0
Length of caudal	12·0
Length of head	10·7
Width of head	8·8
Height of head	·6·0
Length of snout	5·6
Diameter of eye	2·5
Interorbital width	3·0
Depth of body	7·0
Width of body	9·6
Length of caudal peduncle	8·8
Least height of caudal peduncle	3·2
Length of pectoral	13·7
Length of ventral	10·8
Longest ray of dorsal	8·0
Longest ray of anal	5·7

I have named this fish after my teacher, Lt.-Col. J. Stephenson, F.R.S.

Remarks.—Homaloptera stephensoni is known from a single specimen which was referred by Popta (*op. cit.*) to *Helgia modesta* with the following remarks : " Bien que ce poisson du Mahakam supérieur montre quelque petites différences avec la description originale du *H. modesta*, il lui resemble quant à ce qui regarde les caractères principaux. Les différences sont les suivantes : les nageoires pectorales ont 5/11 rayons, les ventrales 2/8 et la caudale 19. La distance interorbitaire est très peu plus large que le diametre des yeux, qui mesurent les 2/9 de la longueur de la tête. Ces différences ne me semblent pas assez grandes pour y reconnaitre la charactéristique d'une nouvelle espèce." I have compared the type of *H. stephensoni* with a typical specimen of *Helgia modesta* and have found that there are other differences between them besides those indicated by Popta. For example, the caudal peduncle of *H. stephensoni* is long and narrow ; its least height being contained 2·7 times in its length ; whereas in *H. modesta* the least height of the caudal peduncle is considerably more than half of its length. The ventral surface is scaly behind the ventrals in *H. modesta ;* whereas in *H. stephensoni* it is smooth as far as the anal-opening. The caudal fin is also different in the two species.

Weber and Beaufort (*op. cit.*) considered *Helgia modesta* Popta (*nec* Vinciguerra) a synonym of *Homaloptera wassinki* Bleeker and remarked as follows : " Miss C. Popta, Ph.D., has called a specimen from river Mahakam, Borneo, *Helgia modesta.* It seems us more probable, that it belongs to *Homaloptera wassinki* Blkr." *H. wassinki* is abundantly distinct from *H. stephensoni* in the possession of relatively smaller eyes and deeper caudal peduncle ; moreover, the ventral surface between and behind the ventrals is scaly in *H. wassinki* and none of the scales of this species are keeled.

In its general build and facies *Homaloptera stephensoni* comes very close to *H. tate-regani* Popta (*op. cit.*, p. 182) which is known from a single specimen collected in the river Bŏ, an affluent of the upper Mahakam. *H. tate-regani*, however, possesses small eyes, small scales which are conspicuously keeled, extremely slender caudal peduncle (its

height more than thrice in its length) and larger number of rays in the pectoral fin (7/12). In *H. stephensoni* the anal is separated from the ventral fin by a considerable distance; whereas in *H. tate-regani* the ventrals almost reach the base of the anal fin. In both these species the ventral surface is naked as far as the anal-opening.

Homaloptera weberi, sp. nov.

(Plate XI, fig. 2.)

1894. *Homaloptera* (*Helgia*) *modesta*, Boulenger (in part, *nec* Vinciguerra), *Ann. Mag. Nat. Hist.* (6) XIII, p. 251 (only name mentioned, no description).

D. 2/7 ; A. 2/5 ; P. 5/11 ; V. 2/7-8. L. l. 44-46.

Homaloptera weberi is a small species in which the ventral profile is straight and horizontal and the dorsal profile is slightly arched. The head and the anterior part of the body are feebly depressed and the ventral surface is flattened. The head is triangular with the snout pointed anteriorly ; its length is contained 4 to 4·3 times in the total length without the caudal and 5·3 to 5·5 times in the length with the caudal. The width of the head in front of the bases of the pectorals is contained about 1·3 times in its length. The height of the head at the occiput is about half the length of the head. The snout is slightly less than half the length of the head and the eyes are mostly in the posterior half of the head. The diameter of the eye is contained 3·8 times in the length of the head and 1·8 times in the length of the snout. The eyes are dorso-lateral in position and are provided with free orbital margins ; they are greatly approximated dorsally so that the interorbital width is less than the diameter of the eye. The nostrils are situated close to the anterior border of the eye. The greatest height of the body is contained 8·7-9 times in the length with caudal and 6·8-7·1 times in the length without caudal. The breadth of the body is slightly less than the width of the head. The caudal peduncle is short and slender, its least height being contained about 2·1 times in its length. The body is covered with moderately small scales which are absent on the head and the anterior flattened part of the body between the pectoral fins. There is a triangular patch of scales in front of the ventrals and the body between and posterior to them is totally scaly. The scales are smooth, and there are 18 scales between the head and the origin of the dorsal fin.

The mouth is situated on the ventral surface slightly behind the tip of the snout ; it is small and slightly arched. The lips are full and do not cover the jaws ; the lower jaw is rounded and is provided with a sharp, rasping edge. When the mouth is closed the lower jaw fits in the concavity of the upper jaw. There are 4 rostral and 2 maxillary barbels ; the latter are somewhat longer than the former.

The dorsal and the anal fins are short ; the former begins behind the ventrals and its origin is equidistant from the tip of the snout and the base of the caudal fin. The pectoral is feebly pedunculate, broad and fan-shaped ; it extends over the base of the ventral for a short distance and is considerably longer than the head. The ventrals are extensive, like the pectorals, and are provided with oblique bases ; they extend beyond the anal-opening but are separated from the anal fin by a considerable distance. The caudal fin is much longer than the head, is narrow and deeply forked. The two lobes are sharply pointed ;

the lower lobe is considerably longer than the upper. Some of the outer rays in the two lobes are fused together.

The colour in spirit is pale-olivaceous with a series of brownish spots along the dorsal surface, the posterior spots of the series descend on the sides and form saddle-shaped bands. There are a few indistinct blotches along the lateral line. The snout is marked with 4 short longitudinal streaks. The pectoral and the ventral fins are provided with 2 black bands and there are one or two zig-zag bands across the caudal fin.

Locality.—Akar River, Sarawak, Borneo. There is a fine series of 8 specimens in the collection of the British Museum of Natural History (No. 95.7.2.81). One of the specimens is in the collection of the Zoological Survey of India.

I have named this species after Prof. Max Weber in recognition of the valuable service rendered by him towards the study of Indo-Australian Fishes.

Measurements in millimetres.

Total length including caudal	63·0	59·0
Length of caudal	14·0	12·4
Length of head	12·0	10·7
Width of head	9·3	8·4
Height of head	5·6	5·2
Length of snout	5·5	5·2
Diameter of eye	3·2	2·8
Interorbital width	2·7	2·5
Depth of body	7·2	6·5
Width of body	9·0	8·0
Length of caudal peduncle	7·8	6·5
Least height of caudal peduncle	3·7	3·0
Length of pectoral	13·5	14·0
Length of ventral	11·0	9·6
Longest ray of dorsal	9·2	8·8
Longest ray of anal	6·4	6·0

Remarks.—A number of specimens collected in Sarawak, Borneo, were erroneously referred by Boulenger to *Homaloptera* (*Helgia*) *modesta*. It has already been pointed out (p. 279) that some of those collected at Senah and in the Tagora River belong to *Homaloptera wassinki* ; whereas those collected in the Akar River belong to the new species *H. weberi*. Weber and Beaufort (1916, p. 9) doubtfully included *H.* (*Helgia*) *modesta* Boulenger (*nec* Vinciguerra) in the synonomy of *Homaloptera wassinki*. *H. weberi* differs from *H. wassinki* in having large, rounded eyes, pointed snout, ventrals extending beyond anal-opening and commencement of dorsal midway between the tip of the snout and the base of the caudal fin. From *H. modesta* it differs in having a larger number of rays in the pectoral fin, a slender caudal peduncle and in having the lower lobe of the caudal fin much longer than the upper. Moreover, in *H. modesta* the commencement of the dorsal fin is nearer to the base of the caudal than to the tip of the snout. From *H. stephensoni* it differs in the possession of large and rounded eyes, smooth scales and a part of the flattened ventral surface covered with scales.

Homaloptera smithi, sp. nov.

(Plate XI, fig. 3.)

D. 2/7 ; A. 1/5 ; P. 6/11-12 ; V. 2/6. L.l. 37-39 ; L. tr. 6/1/4½.

In general facies *Homaloptera smithi* is a *Balitora*-like species in which the head and the anterior part of the body are greatly depressed and the ventral surface is flat and horizontal. The head tapers anteriorly but its apex is broadly pointed, and somewhat trenchant. The length of the head is contained 4·6 to 4·8 times in the total length with caudal, and 3·7 to 3·8 times in the length without the caudal. The width of the head in front of the pectorals is contained 1·3 times in its length. The height of the head at the occiput is contained 2 to 2·3 times in its length. The snout is broad, flat and obtusely pointed ; it is almost as long as or slightly less than half the length of head, and consequently the eyes are situated in the posterior half of the head. The eyes are of moderate size, superior and provided with free orbital margin ; the diameter of the eye is contained 4·4 to 5·1 times in the length of the head, 2·2 to 2·5 times in the length of the snout and 1·3 to 1·9 times in the interorbital width. In the smaller specimens the eyes are proportionately larger and the interorbital space is smaller and more convex. In older specimens the interorbital space is either flat or slightly concave. The nostrils are situated slightly in front of the eye, and are separated by a conspicuous membranous flap. The greatest width of the body in front of the ventrals is contained 6·2 to 7 times in the length with caudal and 4·8 to 5·5 times in the length without the caudal. The depth of the body is greater than that of the head, and is contained 7·7 to 9 times in the length with the caudal and 6·1 to 7·3 times in the length without the caudal. In the young specimens the height of the body is proportionately greater and the width of the body smaller than the same dimensions in the older examples. The caudal peduncle is short and stout, its least height is contained twice in its length. The body is covered with small scales which are absent on the head and the ventral surface as far as the origin of the ventral fins. Between the bases of the ventral fins the scales are irregularly arranged, thin and hardly distinguishable. The dorsal surface of the head is covered with short, wart-like spinous projections which are also present along the free borders of some of the scales. The scales are otherwise smooth. There are about 22 scales in front of the dorsal fin.

The mouth is of moderate size and is situated on the ventral surface slightly behind the tip of the snout ; it is lunate in outline. The upper lip is fleshy and is continuous with the lower lip at the angles of the mouth. In front of the upper lip and forming the anterior border of the snout is the rostral fold, which bears 4 short barbels. The narrow groove between the rostral fold and the upper lip is continued round the angles of the mouth but is widely interrupted across the lower jaw ; at the corners of the mouth it is deeper and broader and is continued backwards and outwards as a narrow channel. There is a barbel in the deep groove at the angle of the mouth. The lower jaw is covered by a thin lip and is shovel-like with a sharp, rasping edge.

The dorsal and the anal fins are short ; the former commences considerably behind the ventrals and its origin is either equidistant between the tip of the snout and the base of the caudal or is nearer the latter than the former. The pectoral fin is pedunculate, broad and fan-shaped ; it extends beyond the origin of the ventral for a considerable distance and is longer than the head. The ventral fin is like the pectoral and is provided with an oblique

base so that the fins on the two sides converge ; it does not extend to the anal-opening which is removed from the anal fin by a considerable distance. The caudal fin is forked with the lobes rounded ; the lower lobe is better developed and is longer than the upper. Some of the outer rays in the two lobes are closely applied together so as to form oar-like structures.

The colour in spirit is brownish on the dorsal surface and the sides ; it is dull white on the ventral surface. The dorsal surface is provided with 6 broad, saddle-shaped black bands, one at the nape, one at the base of the caudal and four prominent ones in between these two. The head and the sides of the body are provided with black blotches and irregular markings. The pectoral fin is provided with 4 irregular bands and the ventral fin with 3. The dorsal and the anal fins are also marked with 2 to 3 bands. The caudal fin possesses two broad bands and a few irregular markings at the base.

Localities.—Tadi Stream and Klong Pong at Ban Kiriwong, Nakon Sritamarat, Peninsular Siam.

Measurements in millimetres.

Total length including caudal	67·3	63·0	54·0	48·0
Length of caudal	12·0	14·2	10·9	10·0
Length of head	14·5	13·0	11·5	10·2
Width of head	11·2	10·0	8·8	7·8
Height of head	6·5	5·5	5·2	5·0
Length of snout .	7·0	6·3	5·5	5·1
Diameter of eye	2·8	2·6	2·4	2·3
Interorbital width	5·3	5·0	3·2	3·0
Depth of body	7·5	7·0	7·0	6·0
Width of body	10·7	10·0	8·7	6·8
Length of caudal peduncle	9·0	10·0	7·2	7·5
Least height of caudal peduncle	4·5	5·0	3·6	3·5
Length of pectoral	16·2	16·5	14·2	11·7
Length of ventral	12·0	12·0	10·6	8·0
Longest ray of dorsal	9·2	9·5	8·0	8·0
Longest ray of anal .	6·6	8·0	6·5	5·6

I have great pleasure in associating this fish with the name of Dr. H. M. Smith of the Department of Fisheries, Siam.

Remarks.—Homaloptera smithi is distinguished from the other species of the genus by the following combination of characters :—the *Balitora*-like general facies, the broad and extensive paired fins, the large eyes, the forward position of the ventrals which do not reach the anal opening, the shovel-like lower jaw and the lepidosis. The colouration as well as the nature of the labial grooves are also characteristic of the species.

So far as my knowledge goes, the following 19 species can be definitely included in the genus *Homaloptera* as characterised above. I have already remarked on the generic position of some of the other species described in this genus (p. 281).

Homaloptera wassinki Bleeker. Java, Sumatra and Borneo.
Homaloptera ophiolepis Bleeker. Java, Sumatra and Borneo.
Homaloptera zollingeri Bleeker. Java, Sumatra and Siam.
Homaloptera ocellata van der Hoeven. Java and Sumatra.

Homaloptera salusur Bleeker. Java and Sumatra.
Homaloptera gymnogaster Bleeker. Sumatra.
Homaloptera modiglianii Perugia. Sumatra.
Homaloptera amphisquamata Weber & Beaufort. Sumatra.
Homaloptera heterolepis Weber and Beaufort. Sumatra.
Homaloptera orthogoniata Vaillant. Borneo.
Homaloptera tate-regani Popta. Borneo.
Homaloptera stephensoni Hora. Borneo.
Homaloptera weberi Hora. Borneo.
Homaloptera smithi Hora. Peninsular Siam.
Homaloptera modesta (Vinciguerra). Siam and Lower Burma.
Homaloptera bilineata Blyth. Lower Burma.
Homaloptera rupicola (Prashad and Mukerji). Upper Burma.
Homaloptera australis (Jerdon). South India.
Homaloptera annandalei (Hora). South India.

It is clear from the above list that most of the species of *Homaloptera* are found in the Indo-Australian Archipelago or in countries in its immediate neighbourhood. The occurrence of two species in South India is a matter of considerable importance, but just at present I am unable satisfactorily to explain their presence there. It is also clear from the above that most of the species possess a very restricted distribution. Five species of *Homaloptera* are found in Java, six in Borneo, nine in Sumatra, three in Siam, two in Lower Burma, one in Upper Burma and two in South India. The genus *Homaloptera* as at present constituted is probably polyphyletic, but from the study of the existing material it seems to me convenient to retain the 19 species listed above under the generic denomination *Homaloptera* van Hasselt *emend.* van der Hoeven.

Attention may be directed here to a species of *Homaloptera* from Perak of which I have examined 2 undetermined specimens preserved in the collection of the Zoologisches Museum der Universität, Berlin. In general facies it corresponds to the large-eyed species of *Homaloptera* and is characterised by the possession of fewer rays in the pectoral fins. The pectoral fin is provided with 12-13 rays of which 4-5 anterior rays are simple. The ventral fin possesses 8 rays of which 2 anterior rays are simple. The air-bladder is like that of *H. rupicola* (p. 277) enclosed in two fairly large, thin-walled bony capsules. These specimens probably represent a new species but as I did not take the full description of the specimens during my visit to Berlin I am now unable to characterise the species and, therefore, refrain from giving it a new name.

The genus *Homaloptera* is found in Java, Sumatra, Borneo, Federated Malay States (Kaula Lumpur and Perak), Siam, Burma and South India.

Sinohomaloptera Fang.

(Plate XII, fig. 1.)

1930. *Sinohomaloptera*, Fang, *Sinensia*, I, p. 26.
1930. *Sinohomaloptera*, Fang, *Contr. Biol. Lab. Sci. Soc. China* (Zool. Ser.), VI, p. 26.

The head and the anterior part of the body are feebly depressed and ventrally flattened. From the dorsal surface the fish appears to be rounded and subcylindrical. The snout

is pointed anteriorly. The eyes are relatively large and are provided with free orbital margins, they are dorso-lateral in position and are not visible from the ventral surface. The mouth is small, inferior, transverse and crescent shaped. The anterior lip covers the jaw, is narrow and is strongly papillated; the papillae are arranged in two series, those of the outer series being very prominent and barbel-like. The posterior lip is also papillated, but here the papillae are not so well-marked. The lower jaw is not covered by the lip anteriorly and possesses a sharp, rasping edge. The lips are continuous at the angle of the mouth and at their union there are 2 barbels, of which the outer is much larger than the inner. In front of the mouth is a deep rostral groove bordered by the rostral fold anteriorly; this groove is continued round the corners of the mouth. There are four rostral barbels arising from the inner wall of the rostral fold, which is produced into a triangular lobe in the middle. The gill-opening is oblique and extends in front of the base of the pectoral to the ventral surface for a short distance. The body is covered with keeled scales, which are absent on the head and the flattened ventral surface in front of the anus. The dorsal surface of the head as far as the tip of the snout is covered with longitudinal rows of keels corresponding to those on the body. The paired fins are horizontal, rounded and of moderate size. The pectoral commences behind the eye and is separated from the ventral by a considerable distance. The ventral is provided with a fleshy appendage in its axil and does not extend to the anal-opening, which is removed from the anal fin. The pectoral fin is provided with 20 rays of which 7-8 are simple. The ventral fin is provided with 10 rays of which two anterior rays are simple. The dorsal and the anal fins are short; the former commences slightly in advance of the latter. The caudal peduncle is long and narrow. The caudal fin is long and deeply emarginate with the lobes pointed; the lower lobe is longer than the upper.

Type.—Sinohomaloptera kwangsiensis Fang.

Fang at first considered *Sinohomaloptera* as a subgenus of *Homaloptera* distinguished by the possession of "Barbels 2 at each angle of the mouth; a deep groove between snout and upper jaw; 8 outer rays of pectoral and 3[1] outer rays of ventral simple." Subsequently, from a study of the basipterygium and of the modified rib, Fang raised *Sinohomaloptera* to the rank of a genus and indicated its affinities with *Hemimyzon*. Quite recently Fang (1931, p. 137) has referred two species from Sze Chuen to this genus which possess greater number of rays in the paired fins and consequently he revised the generic characters of *Sinohomaloptera*. I have discussed the systematic position of the two species from Sze Chuen—*S. yaotanensis* and *S. acuticanda*—in another place (p. 300) and have indicated that in the present state of our knowledge they should be included under *Hemimyzon*, which will have to remain for the time being a composite genus comprising species having diverse affinities.

Sinohomaloptera seems to have diverged along two lines in the course of its evolution, one leading to the genus *Lepturichthys* Regan (p. 292) and the other to certain species of the genus *Hemimyzon* (p. 298). The form of the mouth and the snout; the structure of the lips, jaws and the rostral fold are remarkably similar in *Sinohomaloptera* and *Lepturichthys*. In the latter genus the papillae on the lips are replaced by short barbels, the tail is very slender and long, the snout is more rounded in front, and of the greater number of rays in

[1] I have very carefully studied a specimen of *S. kwangsiensis* in the Zoological Survey and find in it only 2 simple rays in the ventral fins. I have also examined another specimen of the species in the British Museum with similar results.

the ventral 3 are simple. In all these features *Lepturichthys* exhibits a greater degree of modification for life in torrential streams. From *Hemimyzon* the genus *Sinohomaloptera* may be distinguished by the smaller number of rays in the paired fins, in having only 2 simple rays in the ventral fin, a pointed snout and a papillated posterior lip.

Geographical Distribution.—Kwangsi, China (Lin-Yueng-Shien).

In the collection of the Zoological Survey of India there is one specimen of *Sinohomaloptera kwangsiensis*, received in exchange from Mr. P. W. Fang. I have examined a second specimen of the species in the collection of the British Museum.

Balitora Gray.[1]

(Plate X, figs. 1, 6; Plate XI, figs. 5, 6; Plate XII, fig. 2.)

1832. *Balitora*, Gray, *Ill. Ind. Zool.*, I, pl. lxxxviii, fig. 1.
1838. *Balitora*, Swainson, *Nat. Hist. Classification Fish, etc.*, I, p. 366.
1839. *Platycara*, McClelland (in part), *Asiat. Res.*, XIX, pp. 245, 246, 299, 427, 428.
1868. *Homaloptera*, Günther (in part), *Cat. Fish. Brit. Mus.*, VII, p. 340.
1876. *Homaloptera*, Day (in part), *Fish. India*, p. 525.
1889. *Homaloptera*, Day (in part), *Faun. Brit. Ind. Fish.* I, p. 242.
1890. *Homaloptera*, Vinciguerra (*nec* van Hasselt), *Ann. Mus. Cir. Stor. Nat. Genova*, XXIX, pp. 192-196.
1920. *Balitora*, Hora, *Rec. Ind. Mus.*, XIX, p. 197.
1929. *Balitora*, Prashad & Mukerji, *Rec. Ind. Mus.*, XXXI, pp. 187, 188 and 190.

The head and the anterior part of the body are greatly depressed and ventrally flattened. The snout is broad, rounded and provided with trenchant margins. The snout is covered with small and sharp tubercles. The eyes are dorso-lateral, are provided with free orbital margins and are not visible from the ventral surface. The mouth is small, much less than half the width of the head, inferior, transverse and slightly arched. The anterior lip covers the jaw, is narrow and is strongly papillated; there is a series of large papillae on the outer side and of small papillae on the inner side of the lip. The posterior lip is continuous with the anterior at the angles of the mouth, is papillated at the sides and is thin in the middle; it does not cover the edge of the lower jaw which is sharp and strong and covered with a horny substance. In front of the mouth is a deep and narrow groove which extends posteriorly round the angles of the mouth. The rostrum in front of the groove is thickened into a median triangular piece and a small piece on each side of it. The 4 short and thick rostral barbels are situated in between these prominences. There is a small barbel at each angle of the mouth. The gill-opening is oblique and extends in front of the base of the pectoral to the ventral surface for a short distance. The body is covered with small scales which are absent on the head and on the ventral surface in front of the anal-opening. The dorsal and the anal fins are short; the former commences slightly in advance of the latter. The paired fins are broad and horizontal. The pectoral is pedunculate and commences below the eye; it may or may not reach the ventral which does not extend to the anal-opening.

[1] Prashad and Mukerji (*Rec. Ind. Mus.*, XXXI, pp. 187, 188, 1929) have assigned the authorship of the genus *Balitora* to Swainson, but this is not correct. The name was first published by Gray with fairly good and easily recognisable illustrations of two species said to live in the mountain streams of India. This, in my opinion, is a sufficient indication for the genus and Gray in giving names to his two species applied the principles of binary nomenclature. Thus under Art. 25 it is a valid generic name and under Art. 21 Gray has to be recognised as the author of the genus.

The body becomes broader posteriorly from behind the bases of the pectorals and is broadest just in front of the ventrals. The pectoral is provided with 21 rays of which 9 or 10 anterior rays are simple. The ventral possesses 11 rays, of which 2 are simple. The caudal peduncle is long and narrow. The caudal fin is forked and the outer rays in the two lobes are fused together to form oar-like structures.

Type.—Balitora brucei Gray.

The genus *Balitora* is known so far from two species figured by Gray from the mountain streams of India. They may be distinguished by the following key :—

1. Pectorals missing or just reaching the ventrals; lower caudal lobe considerably longer than the upper — *B. brucei.*
2. Pectorals extending beyond commencement of ventrals; lobes of caudal almost equal in length — *B. maculata.*

Of the 2 species, *Balitora brucei* is undoubtedly by far the commonest form as it is represented by a large number of specimens in museum collections. It is widely distributed also and consequently exhibits some interesting variations in form and colouration. I have found this species very common in the Khasi Hills and especially in the torrents below Cherrapunji. In the collection of the British Museum there are 2 young specimens from Darjiling (Nos. 89. 21. 1. 1469-70) and 2 adults from N. E. Bengal (No. 72.4.17.42). These and the Assamese examples constitute the typical form of the species.

The specimens collected by Fea in Burma (Meekalan & Meetan) and reported upon by Vinciguerra (*loc. cit.*) differ from the typical form in having a narrower body, more elongate head and a somewhat darker colouration. The young specimen collected by Dr. B. N. Chopra in Sankha Stream in the Myitkyina District (Prashad & Mukerji, *op. cit.*, p. 190) and a number of young specimens in the collection of the Zoological Survey of India obtained by Mr. R. P. Mullins from the Shishak River, Chittagong Hill Tracts, correspond in general facies to the slender Burmese race of the species. In my opinion this form should be considered as a variety for which I propose the name *burmanicus*, **var. nov.** (plate XI, fig. 6, compare with typical form as shown in fig. 5).

In the collection of the British Museum there is a remarkable specimen of *B. brucei* (No. 1920. 9.8.11) collected by Stockley in the Thaungyin River (Megla Stream) on the Burma-Siam border. In its form it is intermediate between the Assamese and the Burmese races, but it has a striking colouration. The specimen is black on the dorsal surface except the tips of the fins which are dirty-white in colour. It is desirable to recognise this as a separate variety and I propose for it the name *melanosoma*, **var. nov.** (plate X, fig. 6).

In their note on *Balitora brucei* Prashad & Mukerji remark that " in the specimens examined by us there are 3 unbranched rays followed by 8 branched ones in the ventral fins." As the number of simple rays in the paired fins is a character of great diagnostic value in the taxonomy of the Homalopterid fishes I have re-examined the collection in the Zoological Survey and have studied a number of specimens in the different museums in Europe. I have been able to make out only 2 simple rays followed by 9 branched rays in the ventral fins. Mr. D. D. Mukerji has confirmed this number by counting the number of rays in several specimens of the typical form.

Balitora maculata is known to me from 2 very old specimens in the collection of the Indian Museum; they were collected by Dr. Wallich at Darjiling. McClelland (*op. cit.*,

p. 246) states that he obtained several specimens of this genus, corresponding with the spotted species of Gray, *B. maculata*, from Mr. Griffith, who collected them in " Bouton " (=Bhutan). It seems probable that the species is found in the Eastern Himalayas in the neighbourhood of Darjiling. I have made several attempts to locate the habitat of *B. maculata* more precisely, but so far without any success.

That *B. maculata* is found in the Darjiling Himalayas is also evident from the vernacular names that are found on the drawings of the species in the Hardwicke collection. There are 3 sets of drawings of *B. maculata* in the collection, Nos. 109—111 of the volumes containing drawings of the " soft-rayed " fishes. Each set comprises a coloured illustration of the whole fish and a sketch of the ventral surface of the head. The vernacular name given below these drawings is *Nhau-matchee* or *Naw machhy* (Boat fish), *Nhau* or *Naw* meaning boat and *matchee* or *machhy* meaning fish. The vernacular name appears to be of Hindostani origin and lends further support to the view that the species is probably found near Darjiling.

Balitora is closely related to *Hemimyzon*, from which it is distinguished by the presence of only 2 simple rays in the ventral fin (instead of 3 or more) and by the presence of a single barbel at the corner of the mouth (instead of 2). In the number of rays in the paired fins it is parallel to forms like *H. acuticauda* and *H. yaotanensis*; but in its general facies it approaches species like *H. formosanum* and *H. sinensis*. *Sinohomaloptera* approaches *Balitora* in several respects; but possesses a broadly pointed snout, a subcylindrical body and 2 barbels at each angle of the mouth. *Balitora* is distinguished from *Homaloptera* by the possession of a groove in front of the mouth and by the marked pedunculate condition of the pectoral fins. *Balitora* seems to form a connecting link between the broad-headed species of *Homaloptera* and *Hemimyzon*.

Geographical Distribution.—India (Khasi Hills, Assam; Darjiling, Eastern Himalayas and the Chittagong Hill Tracts) and Burma (Meekalan & Meelan, Lower Burma; Myitkyina District, Upper Burma and Megla Stream on Burma-Siam border).

In the collection of the Zoological Survey of India (*Ind. Mus.*) the genus *Balitora* is represented by a large number of specimens.

Lepturichthys Regan.

(Plate X, figs. 7, 8; Plate XII, fig. 3.)

1911. *Lepturichthys*, Regan, *Ann. Mag. Nat. Hist.* (8), VIII, p. 31.

1928. *Lepturichthys*, Nichols, *Bull. Amer. Mus. Nat. Hist.*, LVIII, p. 47.

The head and the anterior part of the body are greatly depressed and ventrally flattened. The tail is long and slender, " with a dorsal and ventral series of plates, which are probably expansions of the neural and haemal spines." The snout is broad and spatulate, and is provided with sharp margins. The eyes are small, dorso-lateral in position and are provided with free orbital margins; they are not visible from the ventral surface. The mouth is small, inferior, transverse and slightly arched. The lips are full and leave the free ends of the jaws uncovered. The anterior lip is produced into 2 or 3 series of barbel-like processes. The posterior lip is also covered with papillae but they are not so prominent. Three pairs of long barbels at the corners of the mouth and a pair of small mandibular barbels in the

middle. Between the anterior lip and the rostral fold there is a deep groove which extends backwards and is continued round the angles of the mouth. There are 4 rostral barbels and between the inner pair the rostral fold is entire, produced into a barbel-like process or into two small processes. The gill-opening is fairly wide ; it extends to the ventral surface for a short distance. The body is covered with small scales which are absent on the head and on the entire flattened ventral surface of the body. The paired fins are extensive, horizontal and fan-shaped. The pectoral begins behind the eye and does not extend to the ventral. The ventral commences opposite to or slightly behind the dorsal ; it does not reach the anal-opening and is separated from the anal fin by a considerable distance. The pectoral fin possesses 19-21 rays of which 7-9 anterior rays are simple. The ventral is provided with 11 or 12 rays, of which 3 anterior rays are simple. The caudal fin is short and narrow ; it is deeply emarginate with the two lobes pointed and the lower lobe is longer than the upper.

Type.—Lepturichthys fimbriata (Günther).

Lepturichthys was briefly characterised by Regan as follows :—" *Lepturichthys*, gen. nov., type *Homaloptera fimbriata* Günth., differs from *Homaloptera* in the long slender tail, with a dorsal and ventral series of plates, which are probably expansions of the neural and haemal spines." Besides this the structure of the lips and the large number of barbels are also characteristic of the genus.

Lepturichthys fimbriata was originally described by Günther (1888) from a single specimen collected at Ichang, but later in 1892 he referred to the same species without any comment two other specimens collected in mountain streams running into the Min River. In 1928 Nichols assigned several specimens collected in the Tungting Lake to *L. fimbriata.* I have carefully studied and compared the specimens obtained in the 3 localities mentioned above and have found that they are specifically distinct. Of the 3 species of *Lepturichthys* known at present two are described here as new. The three species may be distinguished by the following key :—

A. Greater part of dorsal surface of head and body smooth ; low keels on scales in tail region and some scales on anterior part of body provided with spinous projections at their distal ends.
   I. Seven anterior simple rays in pectoral ; longest ray of dorsal shorter than head — *L. fimbriata.*
   II. Nine anterior simple rays in pectoral ; longest ray of dorsal much longer than head — *L. güntheri.*

B. Entire dorsal surface of head and body covered with wart-like spinous processes ; larger scales in front of dorsal with 3 or 4 warts on their distal borders — *L. nicholsi.*

Geographical Distribution.—Upper Yangtse-Kiang River, China (Min River, Sze Chuen ; Ichang, Hupeh and Tungting Lake, Hunan).

In the collection of the Zoological Survey of India there are 2 specimens[1] of *Lepturichthys nicholsi* received in exchange from Dr. J. T. Nichols of the American Museum of Natural History.

[1] Three specimens were received from the American Museum of Natural History, but one was given in exchange to the Museum National d'Histoire Naturelle, Paris.

Lepturichthys fimbriata (Günther).

1888. *Homaloptera fimbriata*, Günther, *Ann. Mag. Nat. Hist.* (6), I, p. 433.

1892. *Homaloptera fimbriata*, Günther in Pratt's *Snows of Tibet*, p. 248, pl. iii, fig. A (original description repeated except for the last line).

D. 3/8 ; A. 2/5 ; P. 7/11-12 ; V. 3/8.

Lepturichthys fimbriata is a long and slender fish in which the ventral profile is straight and horizontal throughout and the dorsal profile is slightly arched. The head and body are greatly depressed and ventrally flattened ; the tail is slightly depressed and is more or less rounded, long, slender and whip-like. The snout is flat and spatulate, considerably narrowed in front and nearly as long as broad. The length of the head is contained 6·3 times in the total length without the caudal and 7·2 times with the caudal. The height of the head at the occiput is half of its width in front of the pectorals which is contained 1·1 times in the length of the head. The eyes are small, dorso-lateral in position and are provided with free orbital margins ; the diameter of the eye is contained 6·4 times in the length of the head, 3·7 times in the length of the snout and 2·5 times in the interorbital width. The snout is more than half the length of the head and consequently the eyes are situated wholly in the posterior half of the head. The interorbital space is almost flat and is grooved in the middle. The depth of the body is contained 12·6 times in the total length without the caudal and 14·5 times with the caudal. The breadth of the body is contained 8·4 times in the total length without the caudal and 9·6 times with the caudal. The length of the caudal peduncle is contained 3·8 times in the total length without the caudal ; its least height is contained about 16 times in its length. The body is covered with minute and smooth scales, which are absent along the entire ventral surface in front of the anal-opening ; there are a few larger scales along the median line of the back and along the lateral line. There are about 82 perforated scales along the lateral line. Some of the scales on the caudal peduncle are marked with low keels.

The mouth is small, inferior, transverse and crescent-shaped ; it is bordered by full lips which are not adherent to the jaws. The anterior lip is produced into 2 or 3 series of barbel-like fringes. The fringes of the lower jaw are not so well marked. At the angles of the mouth there are 3 pairs of rather larger barbels and there is a pair of small mandibular barbels. The anterior lip is separated from the rostral fold by a deep groove which is continued posteriorly round the angles of the mouth. There are 4 rostral barbels that arise from the fold, which is provided with 2 other short processes in the middle.

The dorsal and the anal fins are short ; the former commences slightly in advance of the ventrals and its longest ray is shorter than the head. The origin of the dorsal is equidistant between the tip of the snout and the end of the base of the anal fin. The pectoral fins are broad, horizontal and slightly pedunculate ; they are considerably longer than the head but do not extend to the ventrals. The distance between the bases of the pectoral and ventral fins is greater than the length of the ventral. The ventrals are large but do not reach the anal-opening and are separated from the anal fin by a considerable distance. The caudal fin is short and narrow ; it is deeply forked and has pointed lobes, the lower lobe being better developed and longer than the upper.

The colouration, according to Günther, is as follows : " Body with broad, indistinct, dark cross bands ; pectoral, ventral and caudal fins with greyish spots"

Locality.—Ichang in the Hupeh Province of China.

Lepturichthys fimbriata is known from a single specimen in the collection of the British Museum (No. 88. 5. 15. 40). The two specimens from the Min River which were referred to this species by Günther in 1892 belong to a different species, which is described below as new. The distinguishing features of the two species are given on p. 293.

Measurements in millimetres.

Total length including caudal	116·0
Length of caudal	15·0
Length of head	16·0
Width of head	14·3
Height of head at occiput	7·1
Length of snout	9·3
Diameter of eye	2·5
Interorbital width	6·3
Depth of body	8·0
Breadth of body	12·0
Length of caudal peduncle	29·0
Least height of caudal peduncle	1·8
Length of pectoral	19·0
Length of ventral	16·5
Longest ray of dorsal	15·7
Longest ray of anal	13·5

Lepturichthys güntheri, sp. nov.

(Plate X, fig. 7.)

D. 3/8 ; A. 2/5 ; P. 9/11-12 ; V. 3/9.

Lepturichthys güntheri is a long and slender species in which the ventral profile is straight and horizontal upto the anal fin and the dorsal profile is gracefully arched. The head and body are greatly depressed and ventrally flattened. The snout is broad and spatulate ; it becomes gradually narrower in front, its width being considerably greater than its length. The tail is long, narrow, almost rounded and whip-like. The length of the head is contained 6·2 to 6·9 times in the total length without the caudal. The width of the head is contained 1·2 times and the height of the head at the occiput 2 to 2·2 times in the length of the head. The eyes are small, dorso-lateral in position and are provided with free orbital margins ; the diameter of the eye is contained 6·6 to 7·7 times in the length of the head, 4 to 4·5 times in the length of the snout and 2·8 to 3·0 times in the interorbital width. The snout is more than half the length of the head and consequently the eyes are situated wholly in the posterior half of the head. The interorbital space is slightly convex and grooved in the middle. The nostrils are situated close to the anterior border of the eye. The depth of the body is contained 11·1 to 11·6 times in the total length without the caudal and its width is contained about 8·3 times in the same dimensions. The length of the caudal peduncle is contained 2·9 to 3·2 times in the total length without the caudal ; its least height is contained 19 to 23 times in its length. The body is covered with small and smooth scales which are absent on the head and the entire flattened surface of the body in front of the

anal fin. There are a few larger scales along the median line of the back. Some of the scales in the tail region are slightly keeled, and most of the scales in the anterior part of the body terminate in a short, knob-like projection. There are about 88 perforated scales along the lateral line.

The mouth is small, inferior, transverse and arched ; it is bordered by full lips which are continuous and are not adherent to the jaws. The anterior lip is provided with 2 or 3 series of barbel-like fringes. The fringes of the lower jaw are not so well marked. At the corners of the mouth there are 3 pairs of rather large barbels and there is also a pair of small mandibular barbels in the middle. The anterior lip is separated from the rostral fold by a deep groove which runs posteriorly to the angles of the mouth. The rostral fold is provided with four rostral barbels ; between the inner pair the rostral fold is entire.

The dorsal and the anal fins are short ; the former commences opposite to or slightly in advance of the ventrals ; its longest ray is considerably longer than the head and its commencement is equidistant between the tip of the snout and the end of the base of the anal fin. The pectoral fins are broad, horizontal and slightly pedunculate ; they are considerably longer than the head but do not reach the base of the ventral fin. The distance between the bases of the pectoral and ventral fins is considerably less than the length of the ventral. The ventrals are large, but do not extend to the anal-opening and are well separated from the anal fin. The caudal fin is short and narrow ; it is deeply forked and has pointed lobes, the lower lobe is better developed and is longer than the upper.

The colour in spirit is brownish on the dorsal surface and white on the ventral surface. On the dorsal surface there is a series of broad grey spots separated by streaks of lighter colour. The dorsal surface of the bases of the pectoral and ventral fins is grey and, moreover, they possess a broad band of the same colour across their rays. The dorsal fin is provided with 2-3 bands and the anal fin with one. The caudal fin is marked with a grey patch at its base and a few blotches on its lobes.

Locality.—Mountain streams running into the Min River, Sze Chuen, China. *Lepturichthys günther*i is known from two specimens in the collection of the British Museum (No. 91. 6. 13. 41).

Measurements in millimetres.

Total length without the caudal	99·8	96·0
Length of head	14·5	15·5
Width of head	12·0	12·8
Height of head at occiput	7·0	7·0
Length of snout	8·8	9·0
Diameter of eye	2·2	2·0
Interorbital width	6·2	6·0
Depth of body	9·0	8·2
Width of body	12·0	11·6
Length of caudal peduncle	34·6	30·0
Least height of caudal peduncle	1·5	1·6
Length of pectoral	18·7	18·2
Length of ventral	16·8	15·5
Longest ray of dorsal	18 0	17·2
Longest ray of anal	13·8	13·5

Lepturichthys nicholsi, sp. nov.

(Plate X, fig. 8 ; Plate XII, fig. 3.)

1928. *Lepturichthys fimbriata*, Nichols (*nec* Günther), *Bull. Amer. Mus. Nat. Hist.* LVIII, p. 47.

D. 3/8 ; A. 2/5 ; P. 7-8/11 ; V. 3/7.

Lepturichthys nicholsi is a small and slender species in which the ventral profile is straight and horizontal upto the anal fin and the dorsal profile is slightly arched. The tail is long and rounded like a whipcord. The head and the anterior part of the body are greatly depressed and ventrally flattened. The snout is flat and spatulate ; it tapers gradually towards the anterior end and is rounded at the extremity ; it is somewhat broader than long. The length of the head is contained 5·9 to 6·1 times in the total length without the caudal. The width of the head in front of the bases of pectorals is contained 1·2 times in its length and the height of the head at the occiput 2·1 to 2·2 times in its length. The eyes are small, dorso-lateral in position and provided with free orbital margins ; they are situated mostly in the posterior half of the head and are not visible from the ventral surface. The diameter of the eye is contained 6·1 to 6·3 times in the length of the head, 3·3 to 3·5 times in the length of the snout and 2·3 to 2·4 times in the interorbital width. The interorbital space is more or less flattened with a broad and shallow groove in the middle. The greatest depth of the body is contained 10·4 to 11·2 times and its breadth 7·7 to 9·2 times in the total length without the caudal. The length of the caudal peduncle is contained 3·3 to 3·4 times in the total length without the caudal ; the least height of the caudal peduncle is contained 17 to 18 times in its length. The body is covered with minute scales which are absent on the head and the flattened ventral surface of the body ; the scales behind the head in the middle line and along the lateral line are larger than the others. The entire dorsal surface of the head and body is rugose, each smaller scale being provided with a spinous wart-like process at the distal end and the larger scales having 3 to 4 such processes.

The mouth is small, inferior, transverse and slightly arched ; it is bordered by full lips which are continuous and do not cover the jaws entirely. The anterior lip is produced into 2 or 3 series of barbel-like fringes. The fringes on the posterior lip are not so well marked. There are 3 pairs of well-defined barbels external to the angles of the mouth and a pair of small mandibular barbels in the middle. The anterior lip is separated from the rostral fold by a deep groove which runs backwards round the angles of the mouth. There are four rostral barbels. Between the inner pair of rostral barbels the fold is produced into two barbel-like projections, one of which is sometimes much longer than the other.

The dorsal and the anal fins are short ; the former commences slightly in advance of the ventrals and its longest ray is somewhat shorter than the head. The commencement of the dorsal is slightly nearer to the end of base of anal than to the tip of the snout. The pectorals are broad, horizontal and slightly pedunculate ; they are longer than the head but do not extend to the ventrals. The ventrals are like the pectorals ; they nearly reach the anal-opening and are separated from the anal fin by a considerable distance. The caudal fin is short and narrow ; it is forked, with the two lobes pointed ; the lower lobe is better developed and is longer than the upper. The rays in the lobes are fused together to form bony plates.

The colour of the young specimen is pale olivaceous, while that of the larger specimen is dark. The body is marked on the dorsal surface with broad cross bands which are separated by narrow bands of pale colour. The fins are without any markings.

Locality.—Tungting Lake, Hunan (China).

The type-specimen is preserved in the collection of the Zoological Survey of India (F 11098/1). *Lepturichthys nicholsi* is a smaller fish and can be readily distinguished by the rugose condition of its entire dorsal surface.

Measurements in millimetres.

Total length excluding caudal	72·8	58·3
Length of head	12·3	9·5
Width of head	10·4	7·8
Height of head at occiput	5·9	4·3
Length of snout	7·0	5·0
Diameter of eye	2·0	1·5
Interorbital width	4·6	3·7
Depth of body	7·0	5·2
Breadth of body	9·4	6·3
Length of caudal peduncle	21·8	17·0
Least height of caudal peduncle	1·2	1·0
Length of pectoral	14·4	11·0
Length of ventral	13·0	8·5
Longest ray of dorsal	12·0	8·4
Longest ray of anal	10·0	7·3

Hemimyzon Regan.

(Plate X, fig. 9 ; Plate XI, figs. 7, 8.)

1911. *Hemimyzon*, Regan, *Ann. Mag. Nat. Hist.* (8), VIII, p. 32.

1919. *Hemimyzon*, Oshima, *Ann. Carnegie Mus.* XII, p. 195.

1930. *Hemimyzon*, Fang, *Contri. Biol. Lab. Sci. Soc. China* VI, p. 27.

The head and the anterior part of the body are greatly depressed and ventrally flattened. The snout is broad and rounded and its margins are trenchant. The eyes are superior with free orbital margins and are not visible from the ventral surface. The mouth is inferior, transverse, slightly arched and of moderate size. The anterior lip is narrow and papillated ; the papillae are arranged in a single series and are fairly prominent. The posterior lip is thin and plain and does not cover the whole of the jaw. The posterior jaw is naked anteriorly and is provided with a sharp and cutting edge which is covered with a hard, horny substance. The lips are continuous and at each angle of the mouth there are 2 minute barbels ; the smaller of the two is situated at the junction of the two lips and the other is below it in a deep groove at the corner of the mouth. In front of the mouth but not coextensive with it, is a broad and deep rostral groove, which is bordered anteriorly by a rostral fold. There are 4 rostral barbels and in between these barbels the rostral fold is produced into broad lobes. At the sides of the mouth are 2 fleshy lobes, above which the rostral groove is continuous with the groove at the angle of the mouth. The gill-opening is continued on the ventral surface for a short distance in front of the base of the pectoral. The body is covered with

small scales, which are absent on the head, on the flattened ventral surface of the body and on the dorsal surface in front of the dorsal fin (see *Sewellia*, p. 315). The paired fins are very extensive, horizontal and are provided with large, curved bases. Between the bases of the pectoral and ventral fins the body gradually becomes broader posteriorly. The pectoral commences below the eye and just reaches the base of the ventral. The ventral does not extend to the anal-opening and is separated from the anal fin by a considerable distance. The pectoral is provided with 22 to 24 rays of which 11 or 12 are simple. The ventral possesses 15 rays of which 4 or 5 are simple. The pectoral fin is broadly pedunculate. The caudal fin is emarginate with the lower lobe considerably longer than the upper. The outer rays of the fin are solidly joined to form oar-like structures.

Type.—Hemimyzon formosanum (Boulenger).

Regan characterised *Hemimyzon* very briefly as follows : " *Hemimyzon*, gen. nov., type *Homaloptera formosanum*, Bouleng., pelvic fins 15- or 16-rayed, with extended bases convergent posteriorly, approximating to the *Gastromyzon* structure." There is only the type-specimen of Boulenger's species in the collection of the British Museum and the above description of the genus is based on the characters of this individual. Oshima has reported on 5 specimens collected in the Taiko River and in these he has found the pectoral fin " extending beyond the origin of ventral ". According to Oshima the number of rays in the pectoral fin is 22, whereas I have counted 24 in the type-specimen. In all other respects the Kaiko River examples seem to agree with the type-specimen in the British Museum.

Psilorhynchus sinensis Sauvage & Dabry de Thiersant (1874) is now definitely included in the genus *Hemimyzon*, though in several respects it is strikingly different from *H. formosanum*. *H. sinensis* (Plate x, fig. 9) was first figured by Dabry de Thiersant (1872) as *Gobius ? Tsin-ting-yu*, but in 1874 it was described as *Psilorhynchus sinensis*. Nichols (1928) referred it to *Homaloptera*, while recently Fang (1930*a*) and I (1931) have included it in *Hemimyzon*. Of this species there is a single specimen in the Muséum National d'Histoire Naturelle, Paris. It is not in a very good state of preservation and unfortunately the parts round the mouth are much injured on account of the specimen being suspended by a thread tied to the lower jaw at one end. The mouth is fairly wide and slightly arched. The rostral fold is narrow and between it and the anterior lip is a deep groove. The rostral fold is indented in the position of the barbels. The upper lip is papillated. The jaws are sharp and covered with a horny substance. There are no scales on the ventral surface upto the anal fin. I could only make out one barbel at each corner of the mouth. There are 26 rays in the pectoral fin, of which 13 are simple. The ventral fin possesses 18 rays, of which 4 are simple. The caudal peduncle is long and narrow and the caudal fin is deeply emarginate with the two lobes acutely pointed ; the lower lobe is longer than the upper. The scales are keeled.

Fang (*op. cit.*) has redescribed *H. sinensis* from a specimen obtained at Loochow in Sze Chuen. According to him there are 2 minute barbels at each angle of the mouth and 12 simple rays in the pectoral fins. In all other respects his description closely agrees with the type-specimen in the Paris Museum. From a study of the basipterygium of this species Fang has concluded that it is intermeditate between *Sinohomaloptera* and *Sinogastromyzon*.

Hemimyzon sinensis (Plate x, fig. 9) differs from *H. formosanum* (Plate xi, fig. 7) not only in its general build and facies, but also in having a whip-like caudal peduncle, a deeply forked caudal fin, the keeled condition of the scales and in having greater number of rays in

the pectoral and the pelvic fins. The structure of the caudal fin is rather remarkable. The outer rays of the two lobes are fused together to form bony plates which, no doubt, help the fish in its darting movements from place to place in torrents.

Recently I (*op. cit.*) assigned *Homaloptera abbreviata* Günther (1892) to the genus *Hemimyzon*, but Fang (1931) has considered it " an intermediate form between *Sinohomaloptera* and *Hemimyzon* " The species is known from a single specimen collected in a tributary of the Min River, Sze Chuen, and is distinct from either of the species referred to above. The head (Plate xi, fig. 8) is long and narrow and broadly pointed ($1\frac{1}{3}$ times as long as broad), the dorsal fin is relatively long (longest ray nearly $1\frac{1}{2}$ times length of head), the caudal peduncle is narrow and whip-like and the caudal fin is long and deeply forked (upper lobe twice as long as head). In *H. formosanum* and *H. sinensis* the head is as broad as long. From *H. formosanum* it is further distinguished by the form of its caudal peduncle and fin and by its long dorsal fin. From *H. sinensis* it is distinguished by the absence of keels on the scales and in having fewer rays in the paired fins (P. 24 ; V. 15). According to Günther there are 23 rays in the pectoral fin. I have counted 24 of which 12 are simple. In the ventral fin 3 anterior rays are simple. Günther has remarked that in *H. abbreviata* the pectorals extend beyond the origin of the ventral. The type-specimen is slightly bent. On the concave side the pectoral extends beyond the commencement of the ventral as is shown in Günther's figure of the species whereas on the other side it hardly reaches the ventral. If the specimen is straigtened then the pectorals are seen to reach the bases of the ventrals.

The structure of the lips, jaws and mouth is essentially the same as in the other two species referred to above.

Two species of *Sinohomaloptera*—*S. yaotanensis* and *S. acuticauda*—have recently been described from Sze Chuen by Fang (1931). Both of these differ from *S. kwangsiensis*, the type of the genus, " in having a smaller body depth, unkeeled but spinous scales, the posterior border of the bases of the pectorals and ventrals not free from the body but firmly connected to it with skin, the uniserial papillae along the upper lip instead of biserial ", etc. In the characters mentioned above the two species agree with the species of *Hemimyzon*. According to Fang the basipterygium of the ventral fin of *Sinohomaloptera yaotanensis* and *S. acuticauda* " is rather in close relationship to that of *Hemimyzon sinensis* (S. & Th.) in its general form and the presence of a very faintly marked short ridge near its anterolateral border " When to these characters are added the larger number of rays in the paired fins and the presence of 3 or more simple anterior rays in the ventral fins, it seems to me clear that these two species of *Sinohomaloptera* from Sze Chuen belong to *Hemimyzon*. *Hemimyzon*, as I recognise it at present including the 5 species referred to above, is a composite genus ; its members show a varying degree of adaptability for life in rapid waters. The five species can be artificially arranged as follows with regard to the number of rays in the paired fins :—

1. *Hemimyzon acuticauda* (Fang)	P. 20 (18-21) ;	V. 12 (12-13).
2. *Hemimyzon yaotanensis* (Fang)	P. 20 (19-21) ;	V. 12 (11-14).
3. *Hemimyzon formosanum* (Boulenger)	P. 22-24 ;	V. 15.
4. *Hemimyzon abbreviata* (Günther)	P. 24 ;	V. 15.
5. *Hemimyzon sinensis* (Sauvage & Dabry)	P. 26 ;	V. 18.

These species are divergent in several respects, as indicated above, but as regards the mouth, lips, jaws and the neighbouring parts they are essentially similar. They possess at

least 3 anterior simple rays in the ventral fin and this distinguishes them from the allied genera *Sinohomaloptera*[1] and *Balitora* both of which possess only 2 anterior simple rays in the ventral fin. All these genera approximate to the *Sinogastromyzon* structure.

Geographical Distribution.—Formosa (C. Formosa and the Taiko River) and Sze Chuen, China (Min River, Lun-chan-shien, Yao-tan, Wa-chang and Luchow).

Attention may here be directed to a specimen of *Hemimyzon yaotanensis* figured by Fang in which the " head and body are much wider, the pectorals overlap the anterior border of the ventrals, which is extending to the vent ". This specimen in its general facies is very much like *H. formosanum.*

As *Hemimyzon abbreviata* is insufficiently characterised I take this opportunity to give its full description here.

Hemimyzon abbreviata (Günther).

(Plate XI, fig. 8.)

1892. *Homaloptera abbreviata,* Günther in Pratt's *Snows of Tibet,* p. 248.

1931. *Hemimyzon abbreviata,* Hora, *Rec. Ind. Mus.* XXXIII, p. 68.

D. 3/8 ; A. 2/5 ; P. 12/12 ; V. 3/12 ; L.l. 75.

The head and body of *Hemimyzon abbreviata,* though relatively narrow, are greatly depressed and ventrally flattened. The dorsal profile is slightly arched, whereas the ventral profile is straight and horizontal throughout. The tail is muscular, rounded and whip-like. The head is narrow, elongate and rounded anteriorly ; its length is contained 6·8 times in the total length and 5 times in the length without the caudal. The length of the head is little over twice its height at the occiput and 1·4 times its width in front of the bases of the pectoral. The snout is more than half the length of the head. The eyes are small, dorso-lateral and are provided with free orbital margins ; they are not visible from the ventral surface. The diameter of the eye is contained 7 times in the length of the head, 4 times in the length of the snout and nearly 3 times in the interorbital width. From behind the bases of the pectorals the body becomes broader posteriorly and its greatest width in front of the bases of the ventrals is contained 5·8 times in the length without the caudal ; the height of the body in front of the dorsal fin is contained 7·8 times in the length without the caudal. The nostrils are situated in front of the eye ; the anterior nostril is slightly tubular. The gill-opening is oblique and extends in front of the base of the pectoral to the ventral surface for a short distance. The body is covered with small, smooth scales, which are absent on the head and on the ventral surface in front of the anal fin.

The mouth is inferior, transverse, slightly arched and fairly wide ; the gape of the mouth is contained about twice in the width of the head. The anterior lip is narrow and papillated ; there is a row of prominent papillae and inbetween them are smaller papillae. The anterior lip covers the jaw and is continuous with the posterior lip which is plain, broad and thin. At each corner of the mouth is a barbel with a secondary small barbel at its base. The posterior lip leaves the jaw uncovered anteriorly. The posterior jaw is finely corrugated and is provided with a sharp rasping edge. In front of the mouth there is a deep rostral

[1] In the two specimens of *Sinohomaloptera kwangsiensis* that I have studied the number of anterior simple rays in the ventral fin is 2.

groove which is bordered anteriorly by the rostral fold; the groove is continuous posteriorly round the angles of the mouth. The four rostral barbels arise in indentations in the rostral fold.

The dorsal fin begins behind the commencement of the ventral and its anterior point is much nearer the tip of the snout than the base of the caudal; its longest ray is considerably longer than the head. The pectoral fin is pedunculate, extensive and fan-shaped, it commences just behind the eye but its anteriormost ray is produced into a wing-like extension which forms a distinct notch between the head and the pectoral fin. The pectoral fin reaches the base of the ventral. The ventral fins are also extensive and are provided with convergent bases; their posterior border is truncate and they do not extend to the anal-opening, which is situated in a narrow longitudinal groove at the end of a short papilla. The anal-opening is separated from the anal fin by a distance equal to the diameter of the eye. The anal fin is short and does not reach the base of the caudal; its longest ray is twice the height of the head. The caudal peduncle is long and narrow; its least height is contained about 4·3 times in its length. The caudal fin is long and deeply forked with both the lobes sharp and pointed; the upper lobe is much shorter than the lower and is nearly 1·5 times the length of the head. The outer rays in both the lobes are fused together to form bony plate-like structures for progression in water.

The colouration (from Günther) is as follows:—"Upper parts dark coloured, fins yellowish, lower caudal lobe with a diffuse, blackish longitudinal band."

Locality.—Mountain streams running into the Min River, Province Sze Chuen, China.

The type-specimen (No. 91. 6. 13. 40) is preserved in the collection of the British Museum and is in a very good state of preservation.

Measurements in millimetres.

Total length including caudal	96·0
Length of caudal	25·0
Length of head	14·0
Width of head	10·0
Height of head at occiput	6·6
Length of snout	8·0
Diameter of eye	2·0
Interorbital width	6·0
Breadth of body in front of ventrals	12·3
Height of body in front of dorsal	9·2
Length of caudal peduncle	17·0
Least height of caudal peduncle	4·0
Longest ray of dorsal	17·5
Longest ray of anal	12·5
Length of pectoral	20·0
Length of ventral	16·8

Sinogastromyzon Fang.

(Plate X, figs. 10, 11; Plate XII, fig. 4.)

1930. *Sinogastromyzon*, Fang, *Sinensia* I, p. 35.

1930. *Sinogastromyzon*, Fang, *Contri. Biol. Lab. Sci. Soc. China* VI, p. 33.

The head and the anterior part of the body are greatly depressed and ventrally flattened ; the members of this genus superficially resemble fishes of the genus *Gastromyzon.* The snout is broad, rounded and trenchant. The eyes are superior, with free orbital margins, and are not visible from the ventral surface. The mouth is inferior, transverse, slightly arched and of moderate size. The anterior lip is narrow and papillated ; papillae are arranged in a single series and are fairly prominent. The posterior lip is thin and plain and does not cover the jaw entirely. The posterior jaw is partly naked and is provided with a sharp, anterior edge which is covered by a horny substance. The lips are continuous and at their junctions are two pairs of small barbels. In front of the mouth, but not coextensive with it, is a broad and deep rostral groove, which is partly covered anteriorly by a rostral fold. The rostral fold is indented in the position of the rostral barbels, which are 4 in number. The gill-opening is fairly wide ; it extends in front of the base of the pectoral and is continued on the ventral surface for a short distance. The body is covered with small scales, which are absent on the head and the flattened ventral surface of the body. The paired fins are very extensive, horizontal and fan-shaped ; they are provided with large, curved bases. The pectoral commences considerably in front of the eye and extends beyond the origin of the ventral. The ventral begins in advance of the dorsal, extends beyond the anal-opening, but does not reach the anal fin. The pectoral is provided with 21-28 rays[1], of which 12 outer rays are simple. The ventral possesses 21-23 rays, of which 8 outer rays are simple ; the ventrals are completely united posteriorly to form a suctorial disc. The pectoral fin is provided with a well-developed, broad peduncle. The caudal fin is emarginate with the lower lobe considerably longer than the upper.

Type.—Sinogastromyzon wui Fang.

Sinogastromyzon has been rightly considered by Fang (p. 34) as a genus " in parallel development with *Gastromyzon* in undergoing the same adaptive convergent specialization " Fang has also indicated the sharp distinction that exists between *Gastromyzon* and *Sinogastromyzon.* I (1931, p. 67) have already pointed out that *Homaloptera, Balitora, Hemimyzon* and *Sinogastromyzon* form an evolutionary series in parallel development with a similar series among the Gastromyzoninae. I have referred to these series in greater detail elsewhere (pp. 274, 305, 324).

In *Sinogastromyzon* the pectorals overlap the ventrals, which do not reach the anal fin. In these respects as well as in the form of the mouth this genus resembles *Beaufortia* from China (p. 318).

Sinogastromyzon wui was described by Fang from 3 specimens collected in the province of Kwangsi ; but quite recently he (Fang, 1930*b*) has given an account of a second species obtained from Sze Chuen—*S. szechuanensis.* Of this latter species also only 3 specimens were obtained.

According to Fang. *S. szechuanensis* " is well distinguished from the Kwangsi species *Sinogastromyzon wui* in having a comparatively slender body, less expanded paired fins, greater number of scale rows between origin of dorsal and lateral line, naked dorsal pectoral base and well developed naked muscular band above the base of the ventral, a longer caudal peduncle, and the absence of a strong, flattened and grooved spine in the anterior portion of the anal fin "

[1] " The type has pectorals differing in the number of rays, 22 in the right and 28 in the left " (Fang, p. 38).

Geographical Distribution.—China (Kwangsi, San-fang, Loching-shien and Tung-kwei Lung-chow ; Sze Chuen).

The drawing of the ventral surface of the head reproduced here (Plate xii, fig. 4) was made from a specimen of *Sinogastromyzon wui* kindly lent to me for examination by Mr. P. W. Fang.

Subfamily GASTROMYZONINAE.

The subfamily Gastromyzoninae is characterized by the possession of *one* undivided anterior ray in the paired fins.

[The subtemporal fossae are shallow ; the basipterygium is devoid of a lateral foramen and is provided with a lateral horn ; there is a ligament connecting the medial process of the modified rib with the lateral horn of the basipterygium.]

In the present state of our knowledge eleven genera can be recognised in this subfamily. These may be distinguished by the following key :—

I. Gill-opening of moderate size, extending to ventral surface for short distance.
  A. Definite rostral groove and rostral fold both absent ; rostral barbels fully exposed on ventral surface.
    1. 2 pairs of rostral barbels.
      a. Snout broad and rounded ; mouth slightly arched ; 8 rays in ventral — *Protomyzon*, p. 306.
      b. Snout narrow and elongated ; mouth greatly arched ; 11 rays in ventral — *Annamia*, p. 306.
    2. Several rostral barbels forming a fringe round end of snout — *Crossostoma*, p. 307.
  B. Definite rostral groove, partly covered by rostral fold, present ; primary rostral barbels partly covered by fold.
    1. Mouth-opening of moderate size, more than $\frac{1}{4}$ width of head.
      a. 4 rostral barbels and 3 barbel-like projections of rostral fold — *Vanmanenia*, p. 309.
      b. Several rostral barbels arranged in two series — *Formosania*, p. 311.
    2. Mouth-opening small, less than $\frac{1}{4}$ width of head — *Parhomaloptera*, p. 313.

II. Gill-opening small, situated entirely above base of pectoral.
  A. Ventrals free from each other not united to form a disc-like structure.
    1. 10 rays in ventral . — *Pseudogastromyzon*, p. 313.
    2. 18 rays in ventral . . . . . — *Sewellia*, p. 315.
  B. Ventrals united posteriorly to form a disc-like structure.
    1. Mouth-opening less than $\frac{1}{3}$ width of head ; pectoral extending beyond origin of ventral ; flap of skin between bases of pectoral and ventral absent . — *Beaufortia*, p. 318.
    2. Mouth-opening more than $\frac{1}{3}$ width of head ; in adults pectoral separated from ventral ; flap of skin between bases of pectoral and ventral present.
      a. Breadth of body contained 5 times in total length without caudal ; mouth overhung by a fold bearing rostral barbels — *Neogastromyzon*, p. 319.
      b. Breadth of body contained 3·2 times in total length without caudal ; mouth fully exposed ; rostral barbels considerably in front of mouth . . — *Gastromyzon*, p. 321.

In the case of the genera of the Homalopterinae it has been possible to indicate their probable evolution and phylogeny, but in the present state of our knowledge the relationships of a number of genera in the Gastromyzoninae are obscure. I have indicated elsewhere (p. 273) that the Gastromyzoninae are probably descended from the Cobitidae, and it seems to me likely that they may have been derived from *Nemachilus*-like ancestors. *Nemachilus* is a genus very widely distributed, especially in the Indian region and at high altitudes in Central Asia and in the Far East. It is found in lakes and ponds at high altitudes, in slow-running waters at the bases of hills and in Central Asia, and in turbulent waters everywhere. Consequently, the genus is very plastic and has undergone diverse modifications[1] to populate such a variety of habitats. The torrent-inhabiting forms are depressed, ventrally flattened and are provided with horizontal paired fins. It seems highly probable that such forms diverged from the ancestral stock independently in different parts of the range of their distribution and during the course of evolution in swift currents became modified into such diverse genera as *Protomyzon*, *Annamia*, *Crossostoma*, *Vanmanenia* and *Parhomaloptera*. For instance, it is conceivable that the flattened forms of *Nemachilus* under the continued effect of swift currents became still further flattened, and the number of rays in the pectoral fin became larger for the purpose of adhesion to rocks. *Protomyzon* is undoubtedly such a modified form. If besides these modifications, the rostral barbels were to increase in number in order to test the inspiratory current, we should have a form like *Crossostoma*. *Annamia* seems to have been derived from an ancestor with an elongated and narrow snout. In the remaining genera enumerated above it appears that with the backward shifting of the mouth the skin rolled over the tip of the snout and formed a rostral fold in front of the mouth. The rostral groove is presumably an adaptation for respiration and its peculiar form in *Parhomaloptera* can be accounted for on this assumption. There is hardly any doubt that *Formosania* is a highly modified form of *Vanmanenia*. Thus it appears very probable that the genus *Nemachilus* (or some other similar forms) gave rise independently to a number of genera by a diversity of modifications of its generalised structure.

From what is known at present it is not even possible to guess the origin and probable line of evolution of the remaining 5 genera of the Gastromyzoninae, characterised by a small gill-opening above the base of the pectoral fin, an adaptive character undoubtedly induced by living in very swift currents, as is shown elsewhere (p. 326). In 3 of these genera—*Beaufortia*, *Neogastromyzon* and *Gastromyzon*—the ventral fins are united posteriorly to form a disc-like structure. There seems to me no doubt that this character arose independently in the three genera under the same or a series of similar factors in their respective environments. *Neogastromyzon* and *Gastromyzon* are end twigs of branches of evolution which cannot be discerned ; whereas *Pseudogastromyzon*, *Sewellia* and *Beaufortia* have a number of characters in common, but how far they denote genetic affinity it is not possible to say. *Pseudogastromyzon*, with a small number of rays in the ventral fins is undoubtedly a primitive form in this group of 5 genera. The rostral groove and the rostral barbels of *Sewellia* are highly specialised for respiration (p. 327), and, so far as I am aware, similar structures are

[1] A series of adaptive modifications in the air-bladder of *Nemachilus* has been discussed by me in *Proc. Seventeenth Indian Sci. Cong.*, pp. 229-243 (1930).

not found in any other fish. *Pseudogastromyzon* and *Beaufortia* are possibly genetically related, and their geographical distribution indicates, to a certain extent, their close affinity.

From the above it seems probable that a great many new forms still remain to be discovered in this subfamily, and till such material becomes available it will not be possible to understand the probable origin and evolution of the highly specialised genera. At present we seem to know only the roots and end twigs of the phylogenetic tree of this subfamily, and it is extremely unfortunate that the available material of the known genera is so small that a comparative morphological study, with a view to elucidate their affinities, is also at present out of the question.

Protomyzon, gen. nov.

The head and the anterior part of the body are depressed and ventrally flattened. The snout is broad and rounded. The eyes are dorso-lateral in position, are provided with free orbital margins and are not visible from the ventral surface. The mouth is small, inferior, transverse and slightly arched ; it is bordered by simple fleshy lips. There are 2 pairs of rostral barbels and a pair of maxillary barbels. The rostral fold and the rostral groove are absent. The gill-opening extends to the ventral surface for a short distance. The body is covered with small scales which are absent on the head and the anterior portion of the flattened ventral surface. The paired fins are horizontally placed. The pectoral commences behind the eye and is separated from the ventral by a considerable distance. The ventral extends beyond the anal opening, but does not extend to the anal fin. The pectoral fin is provided with 22 rays of which one outer ray is simple. The ventral fin possesses 8 rays of which 1 outer ray is simple. The dorsal and the anal fins are short, the former commences opposite the ventrals. The caudal fin is emarginate with the lower lobe better developed and slightly longer than the upper.

Type.—Protomyzon whiteheadi (Vaillant).

The genus *Protomyzon* is proposed for *Homaloptera whiteheadi* Vaillant (1893) which is in parallel development with the broad-headed (*Bhavania*-like) species of *Homaloptera*, but is readily distinguished from them by the possession of only one simple outer ray in the paired fins. In general build and facies the new genus resembles certain torrent-inhabiting species of *Nemachilus*, but is distinguished from them by the possession of a large number of rays (22) in the pectoral fin. It seems to me probable that *Protomyzon* may have evolved from *Nemachilus*-like ancestors under the influence of swift currents.

Geographical Distribution.—Borneo (Mount Kina Balu).

The genus *Protomyzon*, as known at present, is monotypic. *P. whiteheadi* is represented in the Paris Museum by 2 large and 5 young specimens, which are very soft and are not in a good state of preservation.

Annamia, gen. nov.

The head and the anterior part of the body are depressed and ventrally flattened. The tail is slender and whip-like. The snout is long, trenchant and broadly pointed. The eyes are dorso-lateral with their upper edges raised above the dorsal profile of the fish ; they are provided with free orbital margins and are not visible from the ventral surface. The

mouth is small, inferior and greatly arched ; it is surrounded by thin continuous lips. The anterior jaw borders the mouth along its anterior curved margin as a prominent ridge and in its concavity fits the shovel-like posterior jaw, which is provided with a sharp, rasping edge anteriorly. In front of the mouth is a depression, well-marked posteriorly but becoming shallow anteriorly to the tip of the snout. On the sloping sides of this depression are situated the 4 small rostral barbels. There is a barbel at each angle of the mouth. The gill-opening extends to the ventral surface for a short distance. The body is covered with small, thin and closely adhering scales, which are absent on the head and the entire ventral surface. In the region behind the anal opening small, rudimentary, isolated scales can be made out by careful examination. The dorsal and the anal fins are short. The paired fins are large and fan-shaped. The pectoral begins considerably behind the eye and is widely separated from the ventral. The ventral just reaches the anal opening but is separated from the anal fin by a considerable distance. The pectoral fin is provided with 17 rays of which one outer ray is simple. The ventral is provided with 11 rays of which the outer one is simple. The caudal fin is emarginate with the outer rays fused to form oar-like structures ; its lower lobe is considerably longer than the upper.

Type.—Annamia normani (Hora).

Annamia normani was referred by me to the genus *Parhomaloptera* in 1930[1], but subsequent work on the Homalopterid fishes has convinced me that *Parhomaloptera microstoma* and " *P. normani* " cannot be grouped in the same genus. The latter has, therefore, been made the type of a distinct genus here. It has already been remarked by me that " *P. normani* " is abundantly distinct from *P. microstoma* " in the shape and proportions of its head, in the structure of the horse-shoe-shaped groove in front of the mouth and its relation with regard to the position of the barbels" In *Parhomaloptera* the groove in front of the mouth is partly formed by the rostral fold, which covers the bases of the barbels ; whereas in *Annamia* there is no rostral fold and barbels are placed on the sides of a depression in front of the mouth. The structure of the mouth, lips and jaws and the form of the snout are quite distinct in the two genera.

Geographical Distribution.—Annam (Kontum).

Crossostoma Sauvage.

(Plate X, fig. 12 ; Plate XII, fig. 5.)

1878. *Crossostoma*, Sauvage, *Bull. Soc. Philom Paris* (7), II, p. 88.

1930. *Crossostoma*, Tchang (in part), *Thèses Facult. Sci. Univ. Paris* (A) No. 209 (233), p. 151.

The head and the anterior part of the body are feebly depressed and the form is more or less cylindrical, resembling that of fishes of the genus *Nemachilus*. The snout is smooth and broadly pointed. The eyes are dorso-lateral, are provided with free orbital margins and are not visible from the ventral surface. The mouth is inferior, transverse and slightly arched. The upper lip is fleshy and covers the jaw, but is not adherent to it. The upper jaw is strong and covered by a horny substance. The lower lip is fleshy at the sides and is continuous at the angles of the mouth with the upper lip ; its middle portion is thin and it is notched in the centre. The lower jaw is free from the lip anteriorly and is provided with

[1] Hora, *Ann. Mag. Nat. Hist.* (10) VI, pp. 582-586 (1930). [Refer to this for illustrations of the species.]

a sharp, rasping edge. In front of the mouth and close to the margin of the snout there is a row of several rostral barbels which increase in length towards the outer side. There is a well-developed pair of maxillary barbels and a pair of small labial barbels. The gill-opening extends to the ventral surface for a short distance. Minute scales are present except on the head and the flattened ventral surface between the pectoral fins. The paired fins are somewhat rounded and horizontally placed. The pectoral begins behind the eye and is widely separated from the ventral. The ventral extends beyond the anal opening but does not reach the base of the anal fin ; it is provided with a short, fleshy appendage in its axil. The pectoral is provided with 13 to 15 rays of which one outer ray is simple. The ventral fin possesses 8 to 9 rays of which one outer ray is simple. The dorsal and the anal fins are short, the former commences in advance of the ventrals. The caudal fin is lunate or emarginate.

Type.—Crossostoma davidi Sauvage.

The genus *Crossostoma* was briefly characterized by its author as follows, " Faciés des *Homaloptera*, mais avec une couronne de barbillon autour de la bouche " The only other genus among Gastromyzoninae which shares this character with *Crossostoma* is *Formosania*. I have indicated elsewhere (p. 311) the distinguishing characteristics of the two genera and have discussed in the same place the generic position of the two species of *Crossostoma* described by Nichols (1926, pp. 2-4) from Fukien but wrongly placed by him in *Formosania*.

Tchang (*op. cit.*, p. 151) has referred "*Homalosoma stenosoma* Boulenger" to *Crossostoma*, and has based his description of the species on 2 specimens 70 to 90 millimetres in length. I have examined these two examples in the Museum National d'Histoire Naturelle, Paris, and though they undoubtedly belong to " *H. stenosoma*," they are not congeneric with *Crossostoma davidi* of which there are several specimens in the Paris Museum and I presume, Tchang must have examined them. In *Vanmanenia* (=*Homalosoma*) there is a groove in front of the mouth and there are only 4 rostral barbels. Even if the sharp points on the rostral fold are considered as barbels, then the number of rostral barbels is 7 and they are arranged in two series corresponding with the condition found in *Formosania*. Besides this there are other differences between *Vanmanenia* and *Crossostoma*, for which the descriptions of the two genera (pp. 309, 307) may be compared.

Only three species of the genus *Crossostoma* are known so far and these may be distinguished by the following key :—

A. Rostral barbels well-developed, maxillary barbels much longer than diameter of eye — *C. davidi.*

B. Rostral barbels short, maxillary barbels as long as or shorter than diameter of eye.

a. Diameter of eye 3·8 times in length of snout ; caudal lunate or obliquely truncate — *C. fascicauda.*

b. Diameter of eye 2·4 times in length of snout ; caudal sharply forked for ¼ of its length . . . *C. stigmata.*

Geographical Distribution.—China (Fukien).

Of the type-species—*C. davidi*—the Zoological Survey of India possesses one specimen obtained in exchange from the Paris Museum. There is also a specimen of *C. fascicauda* Nichols in the collection of the Zoological Survey. Besides these two specimens I have

studied one example of *C. davidi* in the British Museum and several specimens of the same species in the Paris Museum.

In the Paris Museum there are 3 half-grown and several young specimens of *Crossostoma*, probably *C. fascicauda*, which are wrongly labelled as *Psilorhynchus fasciatus* (*vide* foot-note on p. 315).

Vanmanenia, gen. nov.

(Plate XI, fig. 9.)

The head and the anterior part of the body are feebly depressed and in general facies the fish resembles some of the torrential loaches of the genus *Nemachilus*. The ventral surface of the head and body in front of the ventrals is flattened and horizontal. The snout is broad and rounded and is much longer than the postocular part of the head. The eyes are superior, are provided with free orbital margins and are not visible from the ventral surface. The mouth is small, inferior, transverse and crescent-shaped. The lips are fleshy, but at the angles of the mouth they are thin and continuous. The anterior lip lies over the jaw loosely and with it overhangs the mouth and partly covers the lower jaw. The posterior lip leaves the jaw free anteriorly, is broadly notched in the middle and is cut up into six broad lobes, which bear short, tentacular papillae like barbels. In a Y-shaped shallow groove at the corner of the mouth is situated the maxillary barbel. Anterior to and concentric and coextensive with the fleshy part of the anterior lip is a groove partly overhung by the rostral fold and containing the 4 rostral barbels. In between the rostral barbels there are triangular extensions of the rostral fold terminating in short tentacular processes which give the false appearance of barbels. At the base of the outer rostral barbel this groove becomes continuous with the Y-shaped groove at the corner of the mouth. The gill-opening is of moderate size and extends to the ventral surface for a short distance in front of the base of the pectoral fin. Extremely small scales are present except on the head and on the ventral surface in front of and between the bases of the pectoral fins. The dorsal and the anal fins are short. The paired fins are of moderate size, horizontal and somewhat rounded. The pectoral begins considerably behind the eye and is separated from the ventral by a great distance. The ventral fin reaches the anal opening but is widely separated from the anal fin, which extends to the base of the caudal fin. The pectoral fin is provided with 13 to 15 rays, of which one outer ray is simple. The ventral fin possesses 8 rays, of which one outer ray is simple. The dorsal fin begins in advance of the ventral, which possesses a fleshy appendage in its axil. The entire lower edge of the appendage is adnate to the fin. The caudal fin is truncate or slightly emarginate.

Type.—Vanmanenia stenosoma (Boulenger).

Vanmanenia stenosoma was described by Boulenger (1901) under the generic name of *Homalosoma*, which he did not characterize anywhere. I shall indicate later that *Homalosoma* has been considered as a misprint for *Homaloptera* by some workers, whereas others regarded it as a valid generic name among the Homalopteridae. The matter was referred to Dr. G. A. Boulenger, who has written to me as follows :—" *Homalosoma stenosoma* is obviously a *lapsus calami* for *Homaloptera stenosoma* and only a *lapsus memoriae* could account for my using *Homalosoma* to denote a new genus, that name being in use for a well known genus of snakes" From a study of the type-specimen and 4 other examples of Boulenger's species I am convinced that it is not a *Homaloptera*, and in my opinion represents

a new genus allied to *Formosania*. I have, therefore, proposed for it the name *Vanmanenia*, and have great pleasure in associating this interesting Chinese genus with the name of my friend Mr. Johan Van Manen, the illustrious General Secretary of the Asiatic Society of Bengal.

To denote the relationship of his new species Boulenger at the end of the description remarked as follows :—" Fishes allied to the one here described have been figured by Dabry de Thiersant, Piscicult. et Pêche en Chine (1872), pl. xxxvii, figs. 9 and 10, under the name of *Gobius* ? *Tsin-ting-yu* and *G.* ? *Pa-chee-tsee-yu*, from Sze Chuen." There seems no doubt that *Gobius* ? *Tsin-ting-yu* (locally known at " Sse-tchuen " as *Leang-chan-hein* as given by Dabry de Thiersant, *loc. cit.*, p. 179) is the same species which was described later in 1874 by Sauvage and Dabry (1874) as *Psilorhynchus sinensis* and which is placed here in the genus *Hemimyzon* (p. 299). As regards the other species, which according to Dabry possesses 18 rays in the pectoral and 10 rays in the ventral and which from the figure appears to have very small scales, it is difficult to say with certainty to which genus it belongs. The fish seems to resemble *Sinohomaloptera* in several respects and it is not unlikely that future researches will show that *Sinohomaloptera* is not restricted in its distribution to the Province of Kwangsi. It is clear from the above that both the species referred to by Boulenger are in no way related to *Vanmanenia stenosoma*.

In 1919 Oshima, considering " *Homalosoma* " a misprint for *Homaloptera*, assigned *H. stenosoma* to his genus *Formosania*. *Vanmanenia* and *Formosania* are closely related, but I have given reasons elsewhere (p. 312) for regarding the two as distinct genera for the time being. Nichols (1925, 1928) adopted the name " *Homalosoma*," but he regarded it as a subgenus of *Homaloptera*. Unfortunately, he did not characterize " *Homalosoma* " nor did he give any character by which it could be separated from *Homaloptera*. In referring to the relationships of his *H. caldwelli* he remarked that " the species is related to *Homalosoma stenosoma* Boulenger, 1901, Ningpo. *Homalosoma* is probably best considered a subgenus of *Homaloptera*, which genus is typically East Indian." It would appear from the above that geographical considerations rather than any structural peculiarities of the species influenced Nichols in regarding " *Homalosoma* " as a sub-genus of *Homaloptera*. *Homaloptera* belongs to the Homalopterinae and is quite distinct from *Vanmanenia* (=*Homalosoma*) which possesses only one simple ray in the paired fins.

Without an examination of the specimen or a neat drawing of the ventral surface of the head it is difficult to be certain of the generic position of *Homaloptera caldwelli*[1], but it seems likely that it may be congeneric with *Vanmanenia stenosoma*. The species was found near Yenping, Fukien (China) and is so far known from a single specimen.

Tchang (1930) referred " *Homalosoma stenosoma* " to the genus *Crossostoma*. I have shown elsewhere (p. 398) that 4+(3) rostral barbels of *Vanmanenia* are quite different from the numerous barbels that surround the mouth of *Crossostoma*.

As I have remarked already *Vanmanenia* in its general build and facies resembles some of the torrential loaches of the genus *Nemachilus*. This influenced me (1931, p. 67) to regard " *Homalosoma* " as a Cobitid rather than as a Homalopterid genus. The structure of its

[1] Tchang (1932) has described a new subspecies of " *Homaloptera* (*Homalosoma*) *caldwelli* " from the Chekiang Province of China. In general fascies it resembles *Vanmanenia stenosoma*, but without a proper description of the mouth and the associated structures, it is difficult to be sure of its generic position.

mouth and the associated parts, however, brings it closer to the Homalopteridae and in this respect it seems to represent an earlier stage in the evolution of the genus *Formosania.*

Geographical Distribution.—Ningpo River, China (Ningpo, Ning Kong Chow and Chekiang). If *Homaloptera caldwelli* be included in *Vanmanenia* then the range of the genus will extend to Fukien, China.

I have examined 5 specimens of *Vanmanenia stenosoma*, 3 in the British Museum and 2 in the Paris Museum. The drawing reproduced here is from a specimen in the British Museum (No. 1927. 10.1.5).

Formosania Oshima.

(Plate XII, fig. 6.)

1919. *Formosania*, Oshima, *Ann. Carnegie Mus.* XII, p. 194.

The head and the anterior part of the body are feebly depressed and somewhat flattened. The fish is stout and elongate with the body fairly well elevated. The snout is broad and rounded. The eyes are dorso-lateral, provided with free orbital margins and are not visible from the ventral surface. The mouth is small, inferior and crescent shaped ; it is bordered by fleshy lips. The anterior lip covers the jaw and overhangs the mouth and the posterior jaw. The posterior lip is padded and bifid in the middle and at the base of these pads are two small barbels. At each corner of the mouth there is a well-developed barbel with a small barbel-like prominence at its base. At the corner of the mouth both the lips are thin and give the false appearance of being interrupted. The edge of the posterior jaw, which is hard and sharp, is not covered by the posterior lip. In front of the mouth is a groove which is partly overhung by the rostral fold. In this groove are situated 7 barbels and in between them the margin of the labial fold is produced into 6 short barbels, thus making 13 barbels arranged in two series in front of the mouth. The rostral groove is continued round the angles of the mouth and is then produced as a shallow depression in an outward direction. The gill-opening extends to the ventral surface for a short distance. The body is covered with small scales. The head and the ventral surface between the pectorals are naked. The rest of the flattened ventral surface, although appearing naked, is covered with indistinct small scales deeply imbedded in the skin. The dorsal and the anal fins are short ; the former commences in advance of the ventral. The paired fins are rounded and horizontal. The pectoral begins behind the eye and is widely separated from the ventral. The ventral extends beyond the anal opening but does not reach the anal fin ; it is provided with a well developed fleshy appendage in its axil. The pectoral is provided with 15 rays, of which one outer ray is simple. The ventral possesses 9 rays, of which one outer ray is simple. The caudal fin is lunate and the caudal peduncle is almost as high as long.

Type.—Formosania lacustre (Steindachner).

According to Oshima the genus *Formosania* is " well distinguished from other genera of the *Homalopteridae* by the presence of numerous barbels, especially by the rostral barbels which are arranged in two series" It seems very likely that Oshima was not aware of Sauvage's (1878) *Crossostoma* from China which is also characterized by the possession of numerous barbels round the mouth. The two genera are, however, quite distinct. In *Crossostoma* there is no groove in front of the mouth and the barbels are arranged in a series near the tip of the snout ; whereas, in *Formosania* there is a groove and a well marked rostral

fold, and the barbels are arranged in two series in front of the mouth. The structure of the lips and jaws is also different in the two genera.

According to Nichols (1926, p. 3) *Formosania* is a subgenus of *Crossostoma*. Unfortunately, he assigns no reasons for this view, nor does he give the distinguishing features which separate *Formosania* from *Crossostoma*. Nichols has referred his two species of *Crossostoma* from Fukien, China, to the subgenus *Formosania*. I have carefully studied a specimen of *C. fascicauda* and am fully convinced that it cannot be placed in *Formosania*. I have reproduced elsewhere (pl. x, fig. 12) a drawing of the ventral surface of its head and the anterior part of the body for comparison with the illustrations of *Formosania* (pl. xii, fig. 6) and *Crossostoma* (pl. xii, fig. 5).

With regard to *Formosania gilberti*, which is a synonym of *F. lacustre* (Steind.), Oshima (*op. cit.*, p. 195), remarked that the " species is very closely related to Boulenger's *Homaloptera stenosoma* (misprinted *Homalosoma*) from Ningpo, China (Proc. Zoöl. Soc. London, March, 1901, p. 270), which seems to belong to the genus *Formosania*. The latter differs from *F. gilberti* in having seven-branched dorsal rays, a smaller number of scales in the lateral line, and slightly shorter head and pectorals" It is difficult to say how Oshima came to the conclusion that " *Homalosoma stenosoma* " belonged to his *Formosania*, because in Boulenger's figure (pl. xxiii, fig. 3) of the species only 6 small barbels are shown and in his description there is no indication that the species possesses " numerous barbels" Elsewhere (p. 309) I have given the diagnostic characters of the genus *Vanmanenia* (=*Homalosoma*) from which it can be seen that though *Formosania* and *Vanmanenia* are closely related, the former is more specialized for life in rapid waters and consequently its rostral groove and fold and the paired fins show special modifications. So far both the genera are monotypic and it is likely that when further material becomes available intermediate forms between them may be discovered. For the present, however, it seems advisable and convenient to treat them as distinct genera.

Formosania lacustre was originally described by Steindachner (1908) as *Homaloptera formosanum*, but as Boulenger (1894) had already described a totally different fish under the name *Homaloptera formosanus*[1] from Central Formosa in 1894, Steindachner's name had to be abandoned under Article 36 of the International Rules of Zoological Nomenclature. However, shortly afterwards a substitute name—*Crossostoma lacustre*—was proposed by Steindachner for his fish.

In 1919, Oshima, who seems to have overlooked both of Steindachner's notes, described *Formosania gilberti*, a new genus and species from the Tamusui River in Formosa. It has been pointed out by Myers[2] (1929), and I agree with him, that Oshima's species is the same as *Crossostoma lacustre* of Steindachner.

It is clear from the above that the genus *Formosania* is hitherto represented by a single species known from Formosa.

Geographical Distribution.—Formosa (Lake Candidius and Tamusi River near Shinten).

In the collection of the Zoological Survey of India (*Ind. Mus.*) there is one specimen of *Formosania lacustre* received in exchange from the British Museum. Besides this, I have examined 4 specimens of the species in the British Museum and one in the Paris Museum.

[1] *Homaloptera formosanus* of Boulenger is a *Hemimyzon* (p. 299).

[2] Myers, *Copeia*, No. 170, April 30, 1929.

Parhomaloptera Vaillant.

(Plate XII, fig. 7.)

1902. *Parhomaloptera*, Vaillant, *Notes Leyden Mus.* XXIV, p. 129.

1916. *Parhomaloptera*, Weber and Beaufort, *Fish. Indo-Austral. Archipel.* III, p. 20.

1930. *Parhomaloptera*, Hora (in part), *Ann. Mag. Nat. Hist.* (10) VI, p. 584.

The head and the anterior part of the body are depressed and ventrally flattened. The body is relatively less broad and fairly elongate. The snout is broad, smooth and rounded. The eyes are dorso-lateral, provided with free orbital margins and are not visible from the ventral surface. The mouth is small, inferior, transverse and lunate. The upper lip is fleshy and partly overhangs the jaw and the mouth. The lower lip is also fleshy and is produced anteriorly into a number of prominences. The lips are sometimes continuous at the angles of the mouth ; but when they are discontinuous an additional pair of barbels[1] is present at the angles of the mouth. There is a horse-shoe-shaped groove in front of the mouth which is partly overhung by the broad rostral fold. In the position of the rostral barbels the rostral fold is indented. Near the corner of the mouth the groove is forked and at the base of the lower channel is a prominent barbel. The gill-opening extends to the ventral surface for a short distance. Small scales are present on the body but they are absent on the head and on the flattened ventral surface of the body. The dorsal and the anal fins are short ; the former commences in front of the ventral. The paired fins are fairly extensive, are rounded and horizontally placed. The pectoral begins behind the eye and is widely separated from the ventral, which extends beyond the anal opening but is considerably removed from the anal fin. The pectoral is provided with 17 to 19 rays, of which one[2] outer ray is simple. The ventral fin possesses 11 rays, of which one outer ray is simple. The caudal fin is deeply emarginate and the lower lobe is considerably longer than the upper. Some of the outer rays of the caudal fin are firmly united to form compact, oar-like propelling structures.

Type.—Parhomaloptera microstoma (Boulenger).

The genus *Parhomaloptera* is monotypic being represented by the type-species—*P. microstoma* (=*P. obscura* Vaillant). In 1930, I referred another species from Annam to this genus but as I have explained elsewhere (p. 307) it represents a distinct genus which is described here as *Annamia*.

Geographical Distribution.—Borneo and Sarawak (Upper Mahakam, river Bluu, and Akar river).

In the collection of the Zoological Survey of India (*Ind. Mus.*) there is one specimen of *Parhomaloptera microstoma* obtained in exchange from the 'sRijks Museum van Natuurlijke Historie, Leiden.

Pseudogastromyzon Nichols.

(Plate XII, figs. 8, 9.)

1925. *Pseudogastromyzon*, Nichols, *Amer. Mus. Novitates*, No. 167, pp. 1 and 2.

1930. *Pseudogastromyzon*, Fang, *Contri. Biol. Lab. Sci. Soc. China, Zool. Ser.* VI, p. 34.

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[1] In the paper cited above I have given reasons for believing that these barbels are the remnants of once continuous lips (p. 583).

[2] I have examined a specimen in the Leiden Museum which possesses two simple rays in the pectoral fins. I consider this condition as an interesting abnormality.

The head and the anterior part of the body are flattened on the ventral surface; but when the fish is seen from above the form is rounded and the body is fairly well elevated. The snout is broad and round and covered with sharp, conical tubercles. The eyes are superior, provided with free orbital margins and are not visible from the ventral surface. The nostrils are close together; the anterior nostril is slightly tubular and the posterior border of the tube is produced into a short flap. The mouth is small, inferior, transverse and crescent-shaped. The upper jaw overhangs the mouth and towards the free end is not covered by the lip. The anterior lip is finely corrugated and in adult specimens is thrown into one or two fine folds near the corner of the mouth. The lower jaw is also naked and is provided with a strong rasping edge anteriorly. The posterior lip is full and is thrown into a complicated series of membranous folds. The two lips are continuous and at each corner of the mouth is a small barbel. In young specimens behind the posterior lip are two broad prominences, which terminate in rounded papillae. In the adult condition these structures are represented by two rounded knobs which are fairly prominent. In front of the anterior lip is the rostral fold, which is fringed along its posterior border, is crescent-shaped, but not coextensive with the lip. At each of its extremities is situated a small barbel. The gill-opening is small, vertical and is situated above the base of the pectoral. Small scales are present on the body except on the head and the flattened ventral surface in front of the anus. The dorsal and anal fins are short. The paired fins are fairly extensive, horizontal and are provided with curved bases. The pectoral begins below the eye and extends beyond the commencement of the ventral. The ventral fin does not reach the anal opening and is separated from the anal fin by a considerable distance. There is a well developed fleshy appendage at the base of the ventral fin. The pectoral fin is provided with 21 rays, of which one outer ray is simple. The ventral fin is provided with 10 rays, of which one outer ray is simple. The ventral fin commences opposite to or slightly in advance of the dorsal. The caudal fin is obliquely truncate, the lower half longer than the upper.

Type.—Pseudogastromyzon fasciatus (Sauvage).

Pseudogastromyzon was proposed by Nichols as a subgenus of *Hemimyzon* with the following remarks:—"Regan, 1911, proposed the genus *Hemimyzon* for *Homaloptera formosana* Boulenger, 1894, Formosa, a species more or less intermediate between *Homaloptera* and *Gastromyzon*. We have a similar undescribed species from the province of Fukien, China, which is here placed in *Hemimyzon*. Certain differences which it shows from *H. formosana*, namely ventral rays 9 to 11 (*versus* 15) and caudal obliquely truncate (*versus* forked), seem to require that it be subgenerically distinguished as *Pseudogastromyzon*, new subgenus." Fang raised *Pseudogastromyzon* to the rank of a genus and pointed out that it "sharply differs from *Hemimyzon* in having only one barbel at each angle of the mouth, without a deep depression between the upper jaw and snout, in having a flap of skin above the ventral axil, less pectoral and pelvic fin rays and *only one simple outer ray in each of these two fins* (1/19—20 & 1/8—10 respectively), and the caudal obliquely truncate." (*Italics* are mine). There are a great many fundamental differences between *Pseudogastromyzon* and *Hemimyzon*, but for the present it is enough to point out that the former genus belongs to Gastromyzoninae and the latter to the Homalopterinae.

As has been pointed out elsewhere (p. 305) *Pseudogastromyzon* seems to indicate the probable evolution of *Beaufortia*. It is interesting to note that Fang, from a study of the

basipterygium of *Pseudogastromyzon*, came to the conclusion that there is an indication of a close relationship of this genus to " *Gastromyzon pingi* " and " *G. leveretti* ", especially to the latter. Moreover, he very rightly considered *Pseudogastromyzon* " as a less specialized stage to *Gastromyzon* "

Only one species of the genus *Pseudogastromyzon* is known so far. I (1931) have indicated already that *P. zebroidus* Nichols is synonymous with " *Psilorhynchus fasciatus* " Sauvage (1878, p. 88). In describing this species Sauvage did not assign any reasons for including it under *Psilorhynchus*, a genus which has until recently (Hora, 1925) been very little understood. Presumably the minute barbels in the fish were overlooked by Sauvage and this character may have influenced him in regarding it as a *Psilorhynchus*. I have examined 3 specimens[1] of Sauvage's species in the collection of the Muséum National d'Histoire Naturelle, Paris, and have compared them very closely with the specimens of " *Hemimyzon* (*Pseudogastromyzon*) *zebroidus* " of Nichols ; I find that the two species are indentical except for minor differences, which are probably due to the size of the specimens. For convenience of reference in future I reproduce here a drawing of the ventral surface of the head of a specimen in the Paris Museum (51·2 mm. in length without the caudal) for comparison with the drawing made from a specimen of " *P. zebroidus* " Nichols.

Geographical Distribution.—The province of Fukein in China.

Through the kindness of Dr. J. T. Nichols the Zoological Survey of India (*Ind. Mus.*) received in exchange 4 specimens of *P. fasciatus*, of these one specimen has been presented to the Muséum National d'Histoire Naturelle, Paris.

Sewellia, gen. nov.

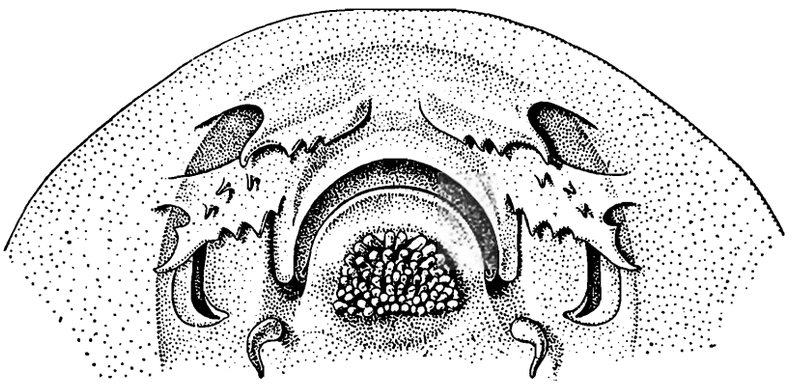
(Plate XI, fig. 10 ; Plate XII, fig. 10.)

The head and the anterior part of the body are greatly depressed and ventrally flattened ; thus, the members of this genus superficially resemble fishes of the genus *Gastromyzon*. The snout is broad, trenchant and more or less rounded. The eyes are superior, provided with free orbital margins and are not visible from the ventral surface. The mouth is small, inferior, semicircular and transverse ; it is bordered by the anterior and the posterior jaws which are not covered by lips towards their free ends ; the anterior jaw overhangs the mouth and to a certain extent the posterior jaw, and is sharp and thin. The posterior jaw is shovel-like and is provided with a strong rasping edge. The anterior lip is simple and is not continuous with the posterior lip, which is somewhat granulated. Concentric with and anterior to the mouth is a semicircular groove, which is fairly broad and towards its termination posteriorly appears[2] to communicate through two oval apertures with the oral cavity. The

[1] There are two lots of specimens labelled as *Psilorhynchus fasciatus* in the Paris Museum. One lot (No. $\frac{3449}{1}$) consists of 11 young specimens which seem to represent a species of *Crossostoma*, but on account of the state of their preservation and size it is difficult to determine them specifically. The other lot (No. 9821) comprises 5 specimens, of which 3 belong to *Psilorhynchus fasciatus* Sauvage, whereas the other 2 probably represent *Crossostoma fascicauda* Nichols which is fairly abundant in Fukein. It seems likely that the young specimens referred to above also belong to this species.

[2] The five specimens of " *Balitora lineolata* " on which this genus is based are nearly a century old, and, consequently, it is very difficult to study them in detail.

four rostral barbels are plate-like at their bases and are situated transversely across the groove ; they are provided with fringed edges and terminate in short, barbel-like processes. The bases of the two anterior rostral barbels are united and the barbels themselves are adnate to the sides of the groove for some distance, thus forming a floor to the groove in the middle. Posterior to the corner of the mouth is a simple small barbel situated on a triangular piece round which runs a fairly deep groove. The gill-opening is small, superior



TEXT-FIG. 4.—Ventral surface of head of *Sewellia lineolata* (C. V.) showing the mouth and its associated structures. ×15.

and vertical ; it is situated above the base of the pectoral. Small scales are present except on the head and the ventral surface in front of and between the bases of the ventral fins. The scales on the dorsal surface in front of the dorsal fin are greatly reduced in size. The dorsal and anal fins are short. The paired fins are large, horizontal and are provided with long, curved bases. The pectoral begins below the eye and extends considerably beyond the commencement of the ventral. The ventral fin extends beyond the anal opening and reaches the anal fin. The pectoral is provided with 22 rays, of which one outer ray is simple. The ventral possesses 18 rays, of which one outer ray is simple. The caudal fin is pointed, the middle rays are considerably longer than the outer ones.

Type.—Sewellia lineolata (C. V.).

It gives me great pleasure to associate this remarkable genus with the name of Lt.-Col. R. B. S. Sewell, Director, Zoological Survey of India, in slight recognition of the encouragement and facilities received for carrying out studies on the torrential populations of India.

So far as the number of rays in, and the form of the paired fins are concerned *Sewellia* approaches very closely the genera *Beaufortia*, *Neogastromyzon* and *Gastromyzon* ; but it can be readily distinguished from them by the fact that the ventrals are not united posteriorly to form a complete disc. *Sewellia* seems to be intermediate between *Pseudogastromyzon* and *Beaufortia*. In the three genera the mouth is small and semicircular and the pectorals overlap the ventrals for some distance. The present geographical distribution of the three genera also lends support to the view that they are related to one another. In general build and facies *Sewellia* resembles *Gastromyzon* more closely than it does either *Beaufortia* or *Pseudogastromyzon*, in both of which the body is considerably elevated. In the nature and character of the rostral groove and barbels *Sewellia* is abundantly distinct from all other genera of the Homalopteridae. If future observations on the respiration of the fish confirm the hypothesis advanced here (p.327) that the inspiratory current passes along the groove

and enters the oral cavity by apertures at its two hinder ends, then in *Sewellia* we shall have a genus highly modified and admirably adapted for clinging to rocks in swift currents.

The genus is at present known from a single species.

Geographical Distribution.—Cochin China.

Only 5 specimens of *Sewellia lineolata* are known of which the Zoological Survey of India (*Ind. Mus.*) obtained one example in exchange and the rest are in the Muséum National d'Histoire Naturelle, Paris[1]. As the species is insufficiently characterized I give below its detailed description so far as it could be drawn up from the old specimens.

Sewellia lineolata (C. V.).

1846. *Balitora lineolata*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* XVIII, p. 99.

D. 9 ; A. 5 ; P. 22 ; V. 18 ; C. 23 ; L. l. 46-50.

Sewellia lineolata is a small fish in which the head and body are greatly flattened and are very broad. The ventral profile is straight and horizontal throughout and the dorsal profile is slightly arched. The snout is broad, rounded and trenchant. The head is contained 5·6 to 5·9 times in the total length and 4·4 to 4·6 times in the length without the caudal. The head is not as broad as the width of the body in front of the ventrals which is contained 3·3 to 3·6 times in the length without the caudal. The eyes are superior and fairly prominent. The diameter of the eye is contained 3·2 to 3·5 times in the length of the head and the eye is situated in the posterior half of the head. The nostrils are situated slightly in front of the eye. The mouth is small, inferior and semicircular. The lips, jaws and barbels are as described for the genus. The body is covered with small scales except on the head and the flattened ventral surface which are naked. The scales on the dorsal surface in front of the dorsal fin are greatly reduced, probably under the influence of the current, and recall the condition already described by me in *Garra abhoyai* Hora (1921). There are about 46-50 scales along the lateral line and 6 series between it and the base of the ventral fin. The dorsal fin originates slightly in advance of the ventral and its commencement is equidistant between the base of the caudal and the tip of the snout or slightly nearer to the latter. The pectoral fin is broad and provided with a fleshy peduncle which is covered with scales on the dorsal surface. The ventrals are convergent posteriorly but are separated by a considerable interval ; they extend to the anal fin, which reaches the base of the caudal fin. The caudal fin is pointed. The caudal peduncle is strong and muscular ; its length is considerably less than its height.

In the preserved specimens the fish is dark-brown in colour. There are 5 longitudinal stripes on the body and 4 similar stripes on the pectoral and ventral fins. The caudal fin is marked with 4 to 5 bands and there are 3 rows of dots on the dorsal fin. The dorsal surface of the head is covered in some specimens with reticulate dark markings.

The specimens, though flabby and unreliable for proportions, etc., are in a fairly good state of preservation, and especially the colour pattern, which induced Cuvier and Valenciennes to give this species the specific name of *lineolata*, is still well-marked.

Locality.—The species was collected by M. Diard during his travels in Cochin China.

[1] The British Museum of Natural History has also obtained in exchange a specimen from the Muséum National d'Histoire Naturelle, Paris.

Measurements in millimetres.

Total length including caudal	55·5	50·5	47·0	42·2	39·5
Length of caudal	11·3	10·0	10·0	8·3	7·6
Height of body[1]	6·6	5·7	5·3	4·7	4·6
Width of body in front of ventrals	13·3	12·2	10·8	9·2	8·7
Length of head	9·5	8·8	8·0	7·6	7·0
Length of snout	5·0	5·0	4·3	4·0	4·0
Diameter of eye	3·0	2·6	2·5	2·2	2·0
Width of head in front of pectorals	12·0	11·0	10·0	8·5	8·8

Beaufortia, gen. nov.

(Plate XII, fig. 11.)

1927. *Gastromyzon*, Nichols and Pope, *Bull. Amer. Mus. Nat. Hist.* LIV, p. 340.

1930. *Gastromyzon*, Fang, *Sinensia*, I, p. 30.

1930. *Gastromyzon*, Fang, *Contri. Biol. Lab. Sci. Soc. China, Zool. Ser.*, VI, p. 35.

The head and the anterior part of the body are depressed and ventrally flattened. When viewed from the dorsal surface the fish appears to be rounded and the body is fairly well elevated. The snout is excerted and is covered with sharp, conical tubercles. The eyes are placed dorso-laterally, provided with free orbital margins and are not visible from below. The mouth is small, inferior, transverse and semicircular. The anterior lip covers the jaw, overhangs the mouth and extends over a part of the posterior jaw ; it is continuous with the posterior lip and at the junction there is a short thick barbel. The posterior lip is papillated along its curved margins and leaves the hard and shovel-like jaw free anteriorly. The skin rolls over on the ventral surface of the head from all sides and forms along the entire margin a fairly broad rostral fold which is indented anteriorly to permit the origin of the 4 short rostral barbels. Thus along the semicircular mouth anteriorly appear 9 lobes, of which 5 belong to the rostral fold, and enclosed between them are the 4 barbels. There are no complicated grooves and channels round the mouth. The rostral fold does not cover the upper lip and jaw. The gill-opening is small and vertical and is placed above the base of the pectoral. Small scales are present, except on the head and the ventral surface in front of and enclosed by the ventral fins. The dorsal and the anal fins are short. The paired fins are large, horizontal and provided with long curved bases. The pectoral commences below the eye and extends beyond the commencement of the ventral by a considerable distance. The ventral fins are convergent posteriorly and are united to form a cup-like structure. There is no flap of skin between the bases of the pectoral and the ventral fins. In the axil of the ventral fin is a flap of skin, which is adnate to the fin on one side and to the body on the other and free posteriorly, thus forming a cup-like structure. The ventral fin may just reach the anal opening or miss it by a considerable distance ; but it is always widely separated from the anal fin. The pectoral is provided with 23 rays, of which one outer ray is simple. The ventral is provided with 17 to 20 rays, of which one outer ray is simple. The dorsal fin begins behind the commencement of the ventral. The

[1] On account of the softness of the specimens the height of the body could not be measured properly. The measurements given here have, therefore, to be taken with considerable reserve.

caudal fin is either obliquely truncate or slightly emarginate ; the lower part of the fin is always longer than the upper.

Type.—Beaufortia leveretti (Nichols and Pope).

I have great pleasure in associating the name of this genus with that of my friend Dr. L. F. de Beaufort in slight recognition of the valuable help received from him during my work at the Zoölogisch Museum, Amsterdam.

Four species of *Gastromyzon* described from China can be referred to the genus *Beaufortia, viz., G. leveretti* Nichols and Pope, *G. pingi* Fang, *G. zebroidus* Fang and *G. szechuanensis* Fang. These species constitute a remarkable group in which the pectoral fins by overlapping the ventral fins complete the formation of a suctorial disc on the ventral surface of the animal and consequently the lateral flaps of abdominal skin between the bases of these fins, so characteristic of *Gastromyzon borneensis* and *Neogastromyzon nieuwenhuisi*, are no longer required and are, therefore, totally absent. The other noteworthy features of this group are the nature of the mouth and the associated parts and the form of the snout. There is hardly any doubt that it is a homogeneous group, the representatives of which have hitherto been found in the torrents of China. The four species[1] of *Beaufortia* may be distinguished by the following key :—

I. Ventrals almost reaching anal-opening	*B. zebroidus.*
II. Ventrals considerably removed from anal-opening.	
A. Caudal fin obliquely truncate	*B. pingi.*
B. Caudal fin distinctly emarginate.	
1. About 75 scales along lateral line	*B. leveretti.*
2. About 137 scales along lateral line	*B. szechuanensis.*

Geographical Distribution.—China (Hainan, Kwangsi and Sze Chuen).

In the collection of the Zoological Survey of India (*Ind. Mus.*) there are two specimens of *Beaufortia leveretti* and one of *B. pingi.* I have also examined a specimen of the latter species in the collection of the British Museum of Natural History (No. 1930.11.7.2).

Neogastromyzon Popta.

(Plate XI, fig. 11 ; Plate XII, fig. 12.)

1905. *Neogastromyzon*, Popta, *Notes Leyden Mus.* XXV, p. 180.

1906. *Neogastromyzon*, Popta, *Notes Leyden Mus.* XXVII, p. 191.

1916. *Gastromyzon*, Weber and Beaufort (in part), *Fish. Indo-Austral. Archipel.* III, p. 2.

The head and the anterior part of the body are depressed and ventrally flattened. From the dorsal surface, the fish appears to be rounded and the body fairly well elevated. The snout is broadly pointed anteriorly and the tip is smooth and rounded. The eyes are placed dorso-laterally, provided with free orbital margins and are not visible from the ventral surface. The anterior nostril is somewhat tubular and is separated from the posterior by the membrane of the tube. The mouth is fairly large, inferior, transverse and slightly curved. On the ventral surface is a broad, smooth rostral fold which overhangs the mouth and covers the upper jaw and the lip. At its free border it is provided with 4 rostral barbels

[1] For detailed account of the species consult the papers referred to under the synonomy of the genus.

and in the middle it is raised into three papillae. There are no complicated grooves near the corners of the mouth and there are no maxillary barbels. At the corner of the mouth there is a triangular fleshy piece uniting the upper and the lower lips and this is provided with a few papillae. The anterior lip[1] appears to be smooth and closely adhering to the jaw. The posterior lip is papillated ; the three papillae in its middle, corresponding to the papillae on the rostral fold, are larger than the others. The posterior jaw is naked, sharp and strong and is covered with a horny substance anteriorly. Behind the posterior lip is a broad and shallow channel running parallel with it. The gill-opening is small and is situated on the dorsal surface above the base of the pectoral fin. Small scales are present except on the head and the flattened ventral surface of the body. The dorsal and the anal fins are short. The paired fins are large, horizontal and provided with long, curved bases. The pectoral fin commences below the eye and is preceded by a thick flap of skin at the sides of head ; it does not reach the ventral fin. The ventral fins are convergent posteriorly and are united to form a cup-like structure. Between the bases of the pectoral and ventral fins there is a flap of skin, which is not so broad as in *Gastromyzon* ; it originates behind the base of the pectoral and terminates above the second ray of the ventral, whence it is closely followed by the fleshy appendage which extends to the 5th or 6th divided ray. The ventral fin just reaches the anal opening but is separated from the anal fin by a considerable distance. The pectoral is provided with 25 rays of which one outer ray is simple. The ventral is provided with 18 rays, of which one outer ray is simple. The dorsal commences behind the commencement of the ventral. The caudal fin is slightly emarginate with the lower lobe somewhat longer than the upper.

Type.—Neogastromyzon nieuwenhuisi Popta.

Miss Popta, who had abundant material of *Gastromyzon borneensis* for comparison, thus distinguished her new genus from *Gastromyzon* : " Le genre *Neogastromyzon* est voisin du genre *Gastromyzon*, Gthr. ; il en diffère par la moindre largeur du corps, par la bouche caractéristique (moins large, plus courbée, à lèvre supérieure cachée), par de grand papilles régulièrement disposées, par 4 barbillons situés sur le bord rostral du dessous, par le pli profond en arrière de la bouche et par la position plus reculée de la nageoire anale " (1906, p. 192). Weber and Beaufort examined the type of *N. nieuwenhuisi* in the Leiden Museum and did not consider it generically distinct from *Gastromyzon borneensis*. In the opinion of these distinguished ichthyologists the proportionate breadth of the body and the position of the anal fin with respect to that of the ventrals are characters of specific rank only. To the other distinguishing features in Popta's definition of *Neogastromyzon* they seemed to have attached no significance. I have very carefully examined the unique specimen of *N. nienwenhuisi* in the Leiden Museum and have compared it very closely with specimens of *Gastromyzon borneensis*. The two species are not only distinct in general build and facies but are totally different as regards the structure of the mouth and associated parts, the form of the snout and the position of the barbels. During my recent visit to Leiden (July, 1931) Professor L. F. de Beaufort very kindly came to the Museum and examined the material of *Gastromyzon* and *Neogastromyzon* and agreed with me in regarding *Neogastromyzon* as a distinct genus from *Gastromyzon*.

[1] It is not possible to make a detailed study of the anterior lip and jaw without dissecting the unique specimen.

The genus *Neogastromyzon* is known from a single species of which one specimen has been found so far.

Geographical Distribution.—Borneo (river Howong).

The drawing of *Neogastromyzon nieuwenhuisi* reproduced here is a copy of the delineation made from the unique specimen under the supervision of Dr. F. P. Koumans and myself.

Gastromyzon Günther.

(Plate XII, fig. 13.)

1874. *Gastromyzon*, Günther, *Ann. Mag. Nat. Hist.* (4) XIV, p. 454.

1889. *Lepidoglanis*, Vaillant, *Compt. rend. Congrès intern. Zool.*, p. 82.

1916. *Gastromyzon*, Weber and Beaufort (in part), *Fish. Indo-Austral. Archipel.* III, p. 2.

The head and the body are greatly depressed and ventrally flattened. The head and the snout are broad and rounded with trenchant margins. The eyes are superior with a free orbital margin, not visible from below. The mouth is large, inferior, transverse and slightly arched. On the ventral surface slightly behind the tip of the snout is a deep, semicircular groove which is hidden by the forward extension of the fleshy part of the anterior lip. This fleshy part of the lip is divided into 3 lobes and at the ends and in between these lobes are 4 rostral barbels[1] in shallow grooves. The groove in front of the lip extends to the bases of the two outer rostral barbels. Below the termination of this groove commences another groove which runs round the angle of the mouth and is continued into the broad and shallow channel, which lies behind the posterior lip and between the commencement of the pectoral fins. In the groove at the corner of the mouth is a small barbel which is covered over by a flap of skin produced by the rolling of the skin at the side of the head. This flap extends backwards over the commencement of the pectoral and gives the head a rounded shape. The anterior lip is divided into two parts, an anterior thickened one and a posterior smooth one. The jaw is sharp, partly exposed, and forms a sort of a hood over the posterior jaw. The posterior lip is tentacular and is hardly continuous with the anterior lip ; it leaves the jaw fully exposed. The posterior jaw is strong, sharp and covered with a horny substance at the tip. The gill-opening is small and is situated on the dorsal surface above the base of the pectoral. Small scales are present except on the head and the flattened ventral surface of body. The dorsal and the anal fins are short. The paired fins are extensive, horizontal and provided with long, curved bases. The pectoral fin begins vertically below the eye and may or may not extend to the base of the ventral.[2] The ventral fins are convergent posteriorly and are united to form a cup-like structure. There is a well-developed flap of skin between the bases of the pectoral and ventral fins ; it originates as a lateral extension of the skin behind the base of the pectoral and extends beyond the origin of the ventral over the bases of four of its anterior rays. With this flap is confluent the appendage[3] which is usually present in the axil of the ventral fin. The flap is covered with scales on

[1] Attention may here be directed to an abnormal specimen, 107 mm. in total length, in the collection of the Zoological Survey of India which possesses 5 rostral barbels, 3 on the right side and 2 on the left side.

[2] In young specimens upto about 45 mm. in total length the pectorals usually extend beyond the commencement of the ventrals; whereas in older specimens these fins are separated from each other.

[3] Stages showing the union of the lateral extension of skin and the appendage can be seen in very young specimens.

the dorsal surface except in the region representing the appendage of the ventral fin. The ventral fin just reaches or extends beyond the anal opening ; it reaches the base of the anal fin or misses it by a short distance. The pectoral is provided with 26-28 rays, of which one outer ray is simple. The ventral possesses 20-21 rays, of which one outer ray is simple. The dorsal commences slightly in advance of the ventral. The caudal fin is obliquely truncate with the lower edge considerably longer than the upper.

Type.—Gastromyzon borneensis Günther.

The remarkable genus *Gastromyzon* was briefly characterized by Günther as follows :— " Dintinguished from *Homaloptera* by having a great number of rays in the ventral fins, which are united into a suctorial disk." This generalized characterisation, though sufficient for the time being, has misled several ichthyologists into grouping diverse fishes under this generic denomination simply because their species possessed the type of ventral fins described by Günther for his *Gastromyzon*. I have shown elsewhere (p. 305) that so far among the Gastromyzoninae three genera can be recognised which have this character in common, and there is also one genus among the Homalopterinae in which the ventrals are united to form a suctorial disc (p. 302).

Only one species of this genus is known so far, and, judging from the number of specimens that are present in the various museums that I have visited, it seems to be fairly abundant in the torrents of Borneo. I have examined the specimens described by Vaillant (1889, 1891, 1893) as *Gastromyzon monticola* in the Muséum National d'Histoire Naturelle, Paris and consider them to be identical with the typical form, *G. borneensis*. The examination of a large series of specimen has shown that the colour varies both with locality and age. Such differences in colour have already been remarked upon by Miss Popta (1906), who was able to divide a lot of 38 specimens ranging in length from 28-105 mm. from 5 localities into 3 types.

Geographical Distribution.—Borneo (" Upper Kapuas, Bongan, Upper Mahakam with its affluents Bō, Blūū, Howong, Kajan, source of the Mingalong, Kadamaian river on Kina Balu, Mount Dulit ").

Gastromyzon borneensis is represented by a large series of specimens in the collection of the Zoological Survey of India (*Ind. Mus.*), Calcutta.

BIONOMICS AND EVOLUTION.

The Homalopteridae have a particular interest on account of their habitat and of the peculiar structural modifications that some of them possess. An account of the ecological factors and the classification of the habitats into which a hill-stream can be divided will be found in one of my earlier papers (1930, pp. 174-178). It may be well, however, to reiterate here very briefly the main factors that govern the life of an organism in swift currents. Of the physical factors, the strength of the current is undoubtedly the most important, for it is inconceivable that an organism could live in torrents without being specially adapted to withstand the rush of the current. The second factor, which is partly dependent on the first and partly on the low temperature of these waters, is the high percentage of oxygen. Experience has shown that the animals have become so modified under the influence of this factor that it is not possible to keep them alive out of hill-streams for any length of time

without elaborate and special arrangements for oxygenating the water in which they may be kept. Of the biological factors, which have induced structural modifications in the Homalopteridae, attention may be specially directed to the nature of the food available in the hill-streams. It mainly consists of algae covering rocks and stones, and of the insect larvae, especially of the Ephemeroptera and the Chironomidae, etc., that live in swift currents. Most of the structural peculiarities of the family noted in the preceding section appear to have been induced by these three principal factors in their environment—current, high percentage of oxygen and the nature of the food available. With this knowledge I shall now attempt to elucidate the probable evolution and increasing specialisation of the Homalopteridae.

It may be well to bear in mind at the outset that all structures are evolved by " the gradual transformation of, addition to, or subtraction from, something already there " (Goodrich, 1924, p. 141), and that environment, by the continuous moulding of pre-existing material, sometimes produces remarkable structures whose affinities are not very easy to discern.

Adhesion and Progression.

The Homalopteridae are found in the mountain streams of Southern Asia, where they live in fast currents closely applied to rocks. *Gastromyzon* has been observed to cling to rocks like a limpet (Günther, 1874, p. 454), and according to Fang (1931, p. 143) a large number of specimens of *Hemimyzon yaotanensis* " are scraped off from the rocks with thin knives " by the natives to be dried or pickled for sale. I have observed *Balitora brucei* in the torrential streams of the Khasi Hills, especially in the Nong-priang stream below Cherrapunji. The fish lives on the exposed surface of boulders in places where the current is the fastest and, when disturbed, darts rapidly from one stone to another across the swiftest current. Like several other torrential fishes the Homalopteridae slowly crawl on stones like a mollusc with the help of their paired fins. Attempts were made to determine by mechanical means the power of adhesion of *Balitora*, but the fish did not adhere firmly to the glass dish in which it was kept, and moved off when touched.

The adhesion to the substratum is partly effected by the close application of the ventral surface of the body, which is flattened and smooth. In a number of species the scales have undergone great reduction, and in the highly specialised genera, such as *Gastromyzon* and *Sinogastromyzon*, they are totally absent in front of the anal fin. Close parallelism exists between the members of the two sub-families as regards the gradual flattening of the body and the reduction of the scales on the ventral surface. There can hardly be any doubt that these modifications have arisen independently in the two sub-families on account of the necessity for clinging firmly to rocks in tempestuous currents.

With the flattening of the ventral surface of the body the paired fins came to lie horizontally, and could then be pressed into service for adhesion. Each fin, especially the pectorals, became modified into two parts, (i) the anterior part consisting of horizontal, thick, flat rays provided on the ventral surface with adhesive pads, which could be applied to the substratum ; and (ii) the posterior part, consisting of normal, obliquely-directed rays, which, by their constant movements, drive away the water from the ventral surface of the fish. This latter action reduces the pressure on the under side of the animal, thus

enabling it to adhere more firmly to rocks. It has been observed in *Balitora brucei* (Hora, 1923, p. 594) that the inner rays stop moving to and fro in still water, thus showing that it is only in rapid waters that their movements are beneficial to the fish. The ceaseless vibrations of the posterior portions (which are turned upwards) of the pectorals in *Hemimyzon yaotanensis* have been observed by Fang (1931), who erroneously associated them with respiration.

The anterior rays of the paired fins, though performing the same function in all the Homalopteridae, are modified differently in the two sub-families. In the Homalopterinae a number of these rays are simple, apparently formed by the coalescence of the two primary branches of an ordinary ray; whereas, in the Gastromyzoninae each primary branch is thickened and flattened, and appears superficially to be a simple ray.

Under the stress of stronger and stronger currents the mechanism of adhesion became more and more efficient by an increase in the number of rays of the paired fins and, consequently, the anterior part of the ventral surface of the body became converted into a broad suctorial disc. Attention may here be directed to the close parallelism that exists between the two sub-families with regard to this character. For example, a series from the Homalopterinae consisting of *Homaloptera*, *Balitora*, *Hemimyzon* and *Sinogastromyzon* can be compared with a series from the Gastromyzoninae comprising *Protomyzon*, *Pseudogastromyzon*, *Sewellia* and *Gastromyzon*. It is to be noted that in the highly specialised genera the posterior rays of the ventral fins, instead of being turned upwards, are inserted obliquely on the ventral surface and by converging towards each other posteriorly become united. By closing the disc at the hinder end in this way the animal is able to restrict the area for the exit of water, so that the current flows under it with greater velocity and consequently the pressure is reduced. The same explanation applies to the presence of lateral flaps of skin between the bases of the pectoral and ventral fins in *Neogastromyzon* and *Gastromyzon*. In these two genera the pectorals are separated from the ventrals, and hence the necessity for the lateral flaps to complete the disc on the ventral surface. In *Beaufortia* and *Sinogastromyzon*, on the other hand, the pectorals overlap the ventrals, and consequently no lateral flaps of skin are needed.

The adhesion of the Homalopterid fishes is further facilitated by the stream-line form of their bodies so that a minimum resistance to the current is offered. In the specialized fishes of the two sub-families the body is greatly depressed and almost limpet-like. The head is short, broad and rounded, and the tail is small, compressed and highly muscular. These modifications probably serve to effect a reduction of the free anterior and posterior parts of the fish so as to keep them as close to the adhesive area as possible, for it is not conducive to life in rapid waters for an animal to have bulky free ends that could be swayed up and down or to and fro by the current.[1] To effect this the head is so much pushed backwards in forms like *Sinogastromyzon*, *Gastromyzon*, etc., that the pectorals arise below or even slightly in front of the eyes.

Another device that has been made use of for reducing resistance is just the opposite of the one described above. In several species the tail is long and narrow so that a stream-line revetment of the body is carried over a long distance to a point. The most remarkable

[1] It has been pointed out by me (*Phil. Trans. Roy. Soc.* London, B, Vol. 218, pp. 230, 231, 1930) that the characteristic form of the Blepharocerid larvae is probably due to the necessity of keeping all the parts of the body in close proximity to the suckers.

form exhibiting this modification is *Lepturichthys*, in which the tail is like a thin cord. In the genus *Homaloptera* the anterior end of some of the species is narrow, long and pointed, whereas in several others it is broad, short and rounded. In the former case the body is usually elevated and subcylindrical ; whereas in the latter case it is depressed and greatly flattened. I presume that both the types are equally capable of reducing resistance. It should be noted, however, that in this case we have the production of totally opposite modifications in the same environment to serve the same purpose. I need hardly mention here the great importance of the form of the body for taxonomic purposes, for it is obvious that the relative proportions of the various parts depend on it.

I have found it difficult to analyse the darting movements of these fishes, but there can hardly be any doubt that they are mainly due to the powerful strokes of the caudal fin. The caudal fin of the Homalopteridae is either obliquely truncate, emarginate or deeply forked, except in *Sewellia* in which it is pointed. It seems to me probable that the form and structure of the caudal fin are governed by the form of the body. As a rule, in small and broad species in which the tail is short and stout, the caudal fin is either truncate or lunate ; whereas, in those in which the tail is long and slender, the fin is usually long and deeply forked. In almost all cases the lower portion of the fin is better developed and is longer than the upper. In a number of Homalopterid genera the marginal rays of the caudal fin are fused together to form compact plate-like structures, to enable the fish to give a powerful stroke during progression. The above remarks apply equally to the members of the two sub-families.

Respiration.

Another result of the flattening of the body, and of the ground habit of the Homalopteridae, is the gradual shifting of the mouth from its anterior, terminal position to a subterminal or an inferior situation. Judging from the build of these fishes and from their habit of applying the ventral surface very firmly to the rocks it might be assumed that the normal respiration, which is effected by the rhythmical suction of water into the oral cavity and its subsequent expulsion through the gill-opening, was almost impossible. In 1923, however, I (1923, p. 594) observed that the method of respiration of *Balitora brucei* is normal. The fish lies at the bottom with its snout raised, thus permitting a current of water to flow under its head. With this supply of water the fish continues to breathe in the normal way. The gill-cover is specialised in two portions, the upper portion, which is provided with a membrane, is used for respiration ; whereas the lower portion, which is devoid of a membrane, takes no part in the breathing of the animal. Whenever any undesirable particle enters the mouth, the fish throws it out and then moves away to another place. *Balitora* is capable of suspending its respiratory movements altogether for a fairly long time and under such conditions it lies quietly at the bottom with the entire surface pressed against the substratum. It seems probable that the fish adheres firmly during floods by suspending its respiratory movements. Fang (1931) records the following observations on the respiration of *Hemimyzon yaotanensis* : " The respiration, as observed on the live specimens, is remarkable. The animal often closely adheres to the rock surface with the ventral (*sic*) of its body, and in the possession of (*sic*) an inferior mouth and the elongate gill-clefts. It keeps its head

up and down in continuously harmonic motions with the closing and opening of the branchial valves and the ceaseless vibrating of the posterior vertical portions of pectorals while in respiration."

The external modifications which I associate with the mode of respiration in the Homalopteridae can be divided into two groups, the modifications of the gill-openings and the modifications of the mouth, lips and associated structures.

In the Homalopteridae the gill-opening is generally of a moderate size extending obliquely in front of the pectoral fin to the ventral surface for a short distance, but in a number of genera of the Gastromyzoninae it is very small and is situated above the base of the pectoral fin. I presume that in all the Homalopteridae in which the gill-opening is of moderate size only a small upper portion of the opening functions for respiratory purposes, as has been observed in *Balitora brucei*. Further, it is conceivable that in forms like *Pseudogastromyzon*, *Sewellia*, *Beaufortia*, *Neogastromyzon* and *Gastromyzon* this functional part only is retained, whereas, owing to the gradual pushing backwards of the head and to other causes, the lower portion of the opening became obliterated. Unfortunately, the mode of respiration of these fishes is not known, but there seems to be little doubt that it will be found to be normal. It is also probable that these specialised fishes, after taking in a supply of water, retain it in the cavity of the gills for a very long time, and thus the process of respiration may not be continuous. The low temperature of water and the high percentage of oxygen dissolved in it would naturally tend to slow down the rate of breathing.

Hemimyzon and *Sinogastromyzon* are similar to *Pseudogastromyzon*, *Gastromyzon*, etc., as regard the form of the head and body, and the forward position of the pectorals; but it is extremely remarkable that the gill-openings in the two series have not undergone similar modifications, although used for the same purpose in the same environment. In the former the gill-openings are still fairly large, are obliquely directed forwards and extend to the ventral surface for a short distance; whereas, in the latter they are small and restricted above the base of the pectoral fin. The more generalised forms in both the series are identical, and without a knowledge of the mode of breathing in the specialised forms it is not possible to comment on the divergent modifications of the gill-openings. They seem to indicate, however, that the Homalopterinae and the Gastromyzoninae probably represent two entirely different stocks, as has already been pointed out elsewhere (p. 272).

With regard to the modifications exhibited by the mouth and the associated structures, special attention may be directed to the nature of the grooves that surround the mouth and to the form and position of the barbels. With the exception of a few forms, the Homalopteridae are provided with a broad rostral groove in front of the mouth, which is continued at the sides to join the grooves at the corners of the mouth. It seems to me probable that the grooves serve as a catchment area for the water that enters underneath the fish at the anterior end, and ultimately supply the water for the respiration of the fish. Before the water can enter the grooves it is tested by a fringe of barbels or tactile papillae on the rostral fold. In genera like *Crossostoma* and *Formosania* this mechanism seems to have been greatly perfected. Between the grooves and the mouth there are papillated or sometime fimbriated lips which test the water again before it enters the mouth. These elaborate precautions are undoubtedly useful in keeping all undesirable objects from entering the mouth. *Balitora* has been observed to eject any large foreign particles which enter the mouth.

The rostral groove and the rostral barbels of *Sewellia* deserve special mention. Each barbel is plate-like at its base, which is attached to the anterior and posterior borders of the groove, forming a bridge-like structure. Each barbel is provided with fringed edges and terminates in a small process. The bases of the two inner rostral barbels are united with each other, thus forming a floor to the rostral groove in the middle. Near each corner of the mouth the rostral groove possesses an oval aperture, by which it seems to communicate with the oral cavity. It seems to me probable that in *Sewellia* the inspiratory current is not taken in through the mouth but passes directly from the rostral groove to the oral cavity. If this be so, the peculiar form and structure of the rostal barbels can be easily explained—they are guards across the rostral groove to test thoroughly the water that may be flowing into it.

The peculiar rostral groove of *Homaloptera tate-regani* (plate xi, fig. 4) and of *Parhomaloptera*, as well as of some other genera, seems to have been developed and modified for the passage of the inspiratory current, but as no observations on these forms exist it is very difficult to discuss the how and why of these structures. I have, however, attempted to show that the rostral groove, barbels, nature of lips, etc., are characters that have arisen in response to the respiratory mechanism of the fish, and in the diversity of their modifications we recognise some very useful characters for taxonomic purposes.

Feeding.

From the nature of the food available in the hill-streams it is obvious that it has to be scraped off from rocks and stones. For this purpose the lower jaw is hard and strong, and its free end is sharp and shovel-like. The posterior lip does not cover the jaw entirely, but leaves the rasping edge bare. The anterior jaw does not bite against the posterior but is modified to form a vertical plate in front of it. In this way the scraped off algae and slime are prevented from being washed away by the current and are ingested with the help of the respiratory current that probably flows into the mouth from its corners. The mechanism of feeding seems to be partly responsible for the grooves that are found round the mouth, for, if a current were to enter the mouth directly from the anterior end, it would tend to carry away with it a part of the food torn off the rocks.

The above is merely an indication of what, I presume, has happened in these fishes, for our knowledge of the bionomics of the Homalopteridae is very imperfect indeed. There seems no doubt, however, that the evolution of this family has been solely determined by the peculiar factors of their environments, and increased specialisation has always been associated with increased efficiency for life in tempestuous currents. The path of evolution is never straight, and the study of the Homalopteridae has very forcefully indicated its zig-zag nature. Animals living under one set of factors by a slight change in their habitat become subject to another set of factors, which induce totally different modifications. In every case the result is a fine adjustment of the organism to the external conditions of its existence, and it seems clear to me that the modifications are mainly determined by their utility to the organisms concerned. It should be borne in mind, however, that the utility of a structure can only be judged by reference to its function in relation to the environment of the organisms studied.

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EXPLANATION OF PLATE X.

Homalopterid Fishes.

Fig. 1.—Basipterygia of *Balitora brucei* Gray. ×2.

Fig. 2.—Basipterygia of *Gastromyzon borneensis* Günther. ×2.

Figs. 3 and 4.—Two types of head-forms among *Homaloptera*.

Fig. 3.—*Homaloptera bilineata* Blyth. ×4¼.

Fig. 4.—*Homaloptera amphisquamata* Weber and Beaufort. ×2¾.

Fig. 5.—Ventral surface of head and anterior part of body of a typical specimen of *Homaloptera ocellata* van der Hoeven in the Leiden Museum (No. 2723) from the collection of Kuhl and van Hasselt made in Java. ×1¾.

Fig. 6.—Ventral view of the type-specimen of *Balitora brucei* var. *melanosoma*, nov. Nat. size.

Fig. 7.—Ventral view of a type-specimen of *Lepturichthys güntheri*, sp. nov. ×¾.

Fig. 8.—Ventral view of a type-specimen of *Lepturichthys nicholsi*, sp. nov. ×1½.

Fig. 9.—Ventral view of the type-specimen of *Hemimyzon sinensis* (Sauvage and Dabry). ×¾

Fig. 10.—Dorsal view of *Sinogastromyzon wui* Fang. (After Fang).

Fig. 11.—Ventral view of *Sinogastromyzon wui* Fang. (After Fang).

Fig. 12.—Ventral surface of head and anterior part of body of *Crossostoma fascicada* (Nichols). ×2½.

HOMALOPTERID FISHES.

EXPLANATION OF PLATE XI.

Homalopterid Fishes.

Fig. 1.—Lateral view of the type-specimen of *Homaloptera stephensoni*, sp. nov. ×2 (Specimen in Leiden Museum, No. 7633).

Fig. 2.—Lateral view of a type-specimen of *Homaloptera weberi*, sp. nov. ×2.

Fig. 3.—Lateral view of a type-specimen of *Homaloptera smithi*, sp. nov. ×2.

Fig. 4.—Ventral surface of head of *Homaloptera tate-regani* Popta, showing the nature of the respiratory channels round the mouth. ×2⅔.

Fig. 5.—Ventral view of *Balitora brucei* Gray (*forma typica*). Nat. size.

Fig. 6.—Ventral view of *Balitora brucei* var. *burmanicus*, nov. Nat. size.

Fig. 7.—Ventral surface of head and anterior part of body of the type-specimen of *Hemimyzon formosanum* (Blgr.). ×1⅓.

Fig. 8.—Ventral surface of head of the type-specimen of *Hemimyzon abbreviata* (Günther) ×3⅓.

Fig. 9.—Ventral surface of anterior part of head of *Vanmanenia stenosoma* (Blgr.). ×3⅓.

Fig. 10.—Lateral view of *Sewellia lineolata* (C. V.). ×2.

Fig. 11.—Lateral view of middle part of *Neogastromyzon neiuwenhuisi* Popta, showing the continuous nature of the skin-flap and the appendage at the base of the ventral fin. ×2⅓.

HOMALOPTERID FISHES.

EXPLANATION OF PLATE XII.

Homalopterid Fishes.

Fig. 1.—Ventral surface of head and body of *Sinohomaloptera kwangiensis* Fang. $\times 1\frac{5}{7}$.

Fig. 2.—Ventral surface of head and anterior part of body of *Balitora brucei* Gray. $\times 1\frac{5}{7}$.

Fig. 3.—Ventral surface of head and anterior part of body of *Lepturichthys nicholsi*, sp. nov. $\times 2\frac{6}{7}$.

Fig. 4.—Ventral surface of head of *Sinogastromyzon wui* Fang. $\times 2$.

Fig. 5.—Ventral surface of head and anterior part of body of *Crossostoma davidi* Sauvage. $\times 2$.

Fig. 6.—Ventral surface of head and anterior part of body of *Formosania lacustre* (Steind.). $\times 2$.

Fig. 7.—Ventral surface of head and anterior part of body of *Parhomaloptera microstoma* (Blgr.). $\times 3\frac{1}{7}$.

Fig. 8.—Ventral surface of head and body of *Pseudogastromyzon fasciatus* (Sauvage). $\times 1\frac{1}{7}$.

Fig. 9.—Ventral surface of head of a young specimen of *Pseudogastromyzon fasciatus* (Sauvage) in the Paris Museum (51·2 mm. in length without caudal). $\times 2$.

Fig. 10.—Ventral surface of head and body of *Sewellia lineolata* (C. V.). $\times 2\frac{2}{7}$.

Fig. 11.—Ventral surface of head and body of *Beaufortia leveretti* (Nichols). $\times 1\frac{5}{7}$.

Fig. 12.—Ventral surface of head and body of *Neogastromyzon nieuwenhuisi* Popta. $\times 1\frac{5}{7}$.

Fig. 13.—Ventral surface of head and body of *Gastromyzon borneensis* Günther. $\times 1\frac{1}{7}$.

HOMALOPTERID FISHES.