

8. *Report on a Collection of Fishes from the Okovango River,
with Notes on Zambesi Fishes.*

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(With 9 Text-figures.)

IN 1939 Mr. Eedes, Native Commissioner stationed at Runtu on the Okovango River, South West Africa, sent to the South African Museum a collection of Fresh-water Fishes. The specimens were excellently preserved, and in spite of transport difficulties, arrived in perfect condition. Mr. Eedes is to be congratulated on his energy and enthusiasm in making the collection. Very little collecting has been done in the Okovango River, and the collection thus forms a very important addition to the South African Museum collections.

The specimens were identified and a preliminary report sent to Mr. Eedes. Publication of the present fuller report has been delayed by world conditions. In preparing it I have utilised Gilchrist and Thompson's material and the material received by the South African Museum from various collectors since the publication of their monograph in 1917.

Of these collections special mention should be made of those presented by the Rev. Ellenberger from Lealui (Lialui) and the Rev. Jalla from Sesheki (Shesheki) (see map, fig. 1). These have been of great value for comparison with Mr. Eedes' collection.

It may be noted that the Rev. Ellenberger also sent specimens to Dr. Pellegrin at the Paris Museum; and that Pellegrin and Gilchrist and Thompson do not always agree on the identity of their respective specimens which one suspects are really conspecific, having been caught not only at the same locality but very likely also at the same time (see *Synodontis jallae*, *infra*).

In this paper I have commented on some cases of synonymy, which, on the basis of the material examined, seem moderately certain. To be really useful, however, criticism and discussion of synonyms should be based on extensive fresh material; "arm-chair" criticism based on a few odd specimens collected casually here and there often produces ill-considered results. I have tested Regan's suggestions

as to the synonyms of Gilchrist and Thompson's species of Cichlids by examination of the types in the South African Museum.

We are very far from being able to discuss the geographical distribution of the fresh-water fishes of this region in relation to the fish-fauna of other African and South African regions. There are still too many doubtful identifications of recorded species. For example, Pellegrin (1936) records *Barbus burgi* Blgr. from the Cubango River in Angola. I do not for a moment doubt that Pellegrin's material agreed with Boulenger's description, and that the only alternative would have been the institution of a *n.sp.* whose diagnosis would have disclosed no apparent differences from *burgi*.^{*} But I find it impossible to believe that *burgi*, which is a synonym of *burchelli*, a *Red-fin* species inhabiting only a single river system in the S.W. Cape, should also occur in the Angolan highlands. The life-history and the specific characters at every stage of growth must be worked out before we can claim to have a true knowledge of the actual species constituting the fish-fauna of a region[†]

Historical.—Castelnau recorded from Lake Ngami thirteen species obtained for him by one of his "préparateurs" (1861, Mem. Poiss. de l'Afr. Australe), and of these nine have maintained their status as valid species as the outcome of later researches.[‡]

Boulenger (1911, Trans. Zool. Soc. London, xviii, p. 399) described a collection made by Mr. R. B. Woosnam and was able to identify the majority of Castelnau's species, which up to that time had been really *species inquirendae* owing to inadequate descriptions. He recorded twenty-five species, which included all of Castelnau's species except two (*Mormyrus lacerda* and *Hydrocyon vittatus*).

These species were incorporated in Boulenger's classic Catalogue of Fresh-water Fishes of Africa (vols. 1-4, 1909-1916).

Gilchrist and Thompson (1913 and 1917, Ann. S. Afr. Mus., xi, pts. 5 and 6) based their work on Boulenger's Catalogue. They had in addition a collection of Ngami fishes made by Mr. H. F. Kirkham and presented to the South African Museum. Five species were added to the list, two of them being described as new.

^{*} Cf. Trewavas, 1936, Novit. Zool., xl, p. 69. *B. mocoensis* Trew. from Angola compared with *B. burgi*.

[†] Cf. Barnard, Ann. S. Afr. Mus., xxxvi, p. 188, 1943.

[‡] Including *Chromis leuacanthus*, which Boulenger claimed to have recognised as *P. angusticeps*. On the ground that a good description of the latter had been given in 1907, Boulenger in 1911 declined to accept Castelnau's name as he was not quite certain of the identity.

Regan's revision of the *Cichlidae* (1922, *Ann. Mag. Nat. Hist* (9), x, p. 249), however, removed *Tilapia woosnami* Blgr., *T. kirkhami* G. & T., and *Pelmatochromis ngamensis* G. & T. from the list as synonyms. *Paratilapia longimanus* Blgr. was regarded as a synonym of *Serranochromis macrocephalus* (Blgr.), but remained on the list of Ngamiland species. Regan also regarded *T. sheshekensis* G. and T. as a synonym of *T. andersonii*.

In 1923 the South African Museum received a collection from Captain Stigand which contained, however, only species already known from Ngamiland.

With the exception of *Barbus poechii* Stndnr. (1930, *Lohberger, Zool. Anz.*, lxxxviii, p. 246), which is a synonym of *B. trimaculatus*, no more records appear to have been published until Fowler described the results of the de Schauensee Expedition (1931, *Proc. Ac. Nat. Sci. Philad.*, lxxxiii, p. 233) and the Vernay-Lang Kalahari Expedition (1935, *Ann. Transvaal Mus.*, xvi, p. 251). These expeditions added respectively five species, of which three were new, and fifteen species, of which eleven were new.

In the following report, however, I have shown that some of Fowler's species are definitely synonyms, and others probably so. Fowler completely ignores Regan's classification of the *Cichlidae*, and consequently as no anatomical details are given for Fowler's n. spp. (*Tilapia alleni*, *deschauenseei*, *Paratilapia deschauenseae*) one can only guess where they should be placed in Regan's system, or with what species they should be compared.

In 1936 Pellegrin published an important contribution to the ichthyology of Angola (*Arq. Mus. Bocage Lisbon*, vii, pp. 45-62). Part of Pellegrin's material was collected in the Cubango River, which is the upper portion of the Okovango River. His results are therefore particularly useful for comparison with the collection made by Mr. Eedes.

This is the list of species recorded by Pellegrin, together with those collected by Mr. Eedes (see p. 410).

According to the *Zoological Record* (lxxvi, 1939, *Pisces*, p. 60), Tortonese published a paper on Zambesi fishes (*Boll. Mus. Zool. Torino*, xlvi, 1939, p. 73). I have not seen the paper.

Geographical.—Mr. Woosnam stated in his report (in Boulenger, 1911, p. 400) that "although the fish were labelled 'Lake Ngami' for convenience of reference to maps, they come in reality from the Okovango River and vast extent of marshes (of which Lake Ngami is a part) into which the river opens out before it continues its way

	Pellegrin, 1936.	Eedes coll.	Remarks.
<i>Marcusenius cubangoensis</i> Pelleg. . .	x		
<i>Petrocephalus stuhlmanni</i> Blgr. . .		x	
<i>Gnathonemus macrolepidotus</i> (Peters) . .	x		
<i>Mormyrus anchietae</i> Guim.	x		
<i>Hepsetus odoë</i> (Bl.)	x		
<i>Hydrocyon vittatus</i> (Cast.)		x	
<i>Alestes lateralis</i> Blgr.	x		
<i>Micralestes acutidens</i> (Peters)		x	
<i>Petersius woosnami</i> Blgr.	x		
<i>Nannocharax multifasciatus</i> Blgr. . . .		x	
<i>Hemigrammocharax monardi</i> Pelleg. . .	x		
<i>Labeo cylindricus</i> Peters	x		
<i>greeni</i> Blgr.	x		
<i>forskalii</i> Rüppell		x	
<i>parvulus</i> G. and T.		x	
<i>Barbus hypostomatus</i> Pelleg.	x		
<i>rhodesianus</i> Blgr.	x		
<i>trimaculatus</i> Peters	x	x	
<i>paludinosus</i> Peters	x	x	
<i>eutaenia</i> Blgr.	x		
<i>viviparus</i> Weber	x	x	Recorded by Pelle- grin as <i>bifrenatus</i> Fowl., see p. 426. See p. 408.
<i>burgi</i> Blgr.	x		
<i>unitaeniatus</i> Gnthr.	x		
<i>barotseensis</i> Pelleg.		x	
<i>lineomaculatus</i> Blgr.	x		
<i>macrurus</i> G. and T.		x	
<i>lujae</i> Blgr.	x		
<i>barilioides</i> Blgr.	x		
sp. juv.		x	
(<i>Beirabarus</i>) <i>okavangoensis</i>			
Brnrd.		x	
<i>Barilius neavei</i> Blgr.	x		
<i>Clarias gariepinis</i> Burch.	x	x	
<i>ngamensis</i> Cast.	x		
<i>dumerili</i> Stndr.	x		
<i>Schilbe mystus</i> Linn.	x		
<i>Amphilius platychir</i> Gnthr.			
var. <i>cubangoensis</i> Pelleg.	x		
<i>Auchenoglanis ngamensis</i> Blgr.	x	x	
<i>Synodontis nigromaculatus</i> Blgr.	x		
<i>woosnami</i> Blgr.	x		
<i>macrostigma</i> Blgr.	x		
<i>melanostictus</i> Blgr.		x	
<i>jallae</i> G. and T.		x	
<i>Chiloglanis fasciatus</i> Pelleg.	x		
<i>Haplochilus cabindae</i> Blgr.	x		
<i>Hemichromis fasciatus</i> Peters	x		
<i>Pelmatochromis thumbergi</i> (Cast.) . . .	x	x	Now <i>Serranochromis</i> t. ? = <i>S. thumbergi</i> , see p. 447.
<i>genisquamulatus</i> Pelleg.	x		
<i>wehwitschi</i> Blgr.	x		

	Pellegrin, 1936.	Eedes coll.	Remarks.
<i>Tilapia galilaea</i> Art. . . .	×		? = <i>macrochir</i> .
<i>melanopleura</i> Dum. . . .	×	×	
<i>macrochir</i> Blgr. . . .		×	
<i>ovalis</i> Stndr. . . .	×	×	= <i>Haplochromis moffatii</i> .
<i>sparrmanii</i> A. Smith . . .	×	×	
<i>Sargochromis codringtoni</i> . . .		×	
<i>Serranochromis</i> sp.? . . .		×	
<i>Anabas multispinis</i> Peters . . .	×		Now <i>Ctenopoma m.</i>
<i>Mastacembelus mutombo</i> Pelleg. . .	×		

as a single great river known as the Botletle or Zouga." Except that he travelled from Lehutitu to Okwa, Woosnam did not give his itinerary, so that the actual locality or localities are not known. It is clear, however, that "Okovango River" refers to that portion of the river within the political boundaries of Bechuanaland (map, fig. 1).

He refers (p. 401, footnote) to the likelihood of the Okovango marshes being connected with the Chobe marshes in times of flood; and concludes his report with his opinion that: "There are not and never have been any fish in Lake Ngami which are not also in the Okovango and marshes. . . . But that there are fish in the upper waters of the Okovango which are not found in the marshes is highly probable" (p. 402).

The de Schauensee collection was made at Maun on the Thamalakani River (upper or northern reaches of the Botletle). The Vernay-Lang Expedition collected at the same locality, at Tsotsoroga Pan between the Okovango marshes and the Chobe, and in the Chobe River; and also in the Nata River flowing from the east into the Makari-kari Salt Pan.

From the list of recorded species prior to 1930, and taking into account the collections in the South African Museum from the Upper Zambesi River (those received after the publication of Gilchrist and Thompson's work will be included in this report), the fish-fauna of "Ngamiland" appeared to be essentially the same as that of the Zambesi. Fowler's reports, however, seemed to show that there are a certain number of endemic species. This element will very likely be reduced or wholly cancelled when more intensive collecting has been carried out in the Zambesi River, especially in the case of small species of *Barbus*.

The importance of the present collection is that it was made in the

Okovango River far above the area where it branches and loses itself in the marshes of Ngamiland, but below that portion of the selfsame river known as the Cubango River in Angola, whence Pellegrin (1936) obtained his material. The actual locality is Runtu, S. lat. $17^{\circ} 55'$ E. long. $19^{\circ} 43'$, between Andara and Kuringkuru (88 miles east of the latter place) (see map, fig. 1).

FAMILY MORMYRIDAE.

Marcusenius castelnaui Blgr.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 328, and 1917, pp. 578, 579.

1913. *Id. ibid.*, p. 327 (*isidori*, non C. & V.).

1916. Boulenger, Cat. F. W. Fish. Afr., iv, p. 159, fig. 106.

1916. *Id. ibid.*, p. 161 (quotes G. and T's record of *isidori* without comment).

The three specimens from the Kafue River recorded by Gilchrist and Thompson are not in good condition, but are certainly not *isidori*. This latter species should be expunged from the South African faunalist.

As a matter of fact the specimens agree quite well with *castelnaui*. Gilchrist and Thompson's diagnosis seems to be composite. The teeth number respectively from the smallest to the largest $\frac{7}{7}$, $\frac{7}{8}$, $\frac{7}{9}$; in the last case the 3 on the right side of the jaw appear to be replacers and are not pushed up to the level of the other teeth.

There are also in the South African Museum six specimens from Lialui and fifty-four from Sesheki, both localities on the Zambesi, the latter opposite the Linyanti and Chobe swamps. The Sesheki specimens range from 28 to 75 mm. The normal number of teeth seems to be $\frac{7}{8}$. The larger specimens frequently have fourteen scales around the caudal peduncle.

M. discorhynchus Peters, from the Lower Zambesi (Tete), has been recorded by Pellegrin (1920) from Lialui on the upper Zambesi.

M. cubangoensis Pelleg. (1936) from the Cubango River (Upper Okavango River) differs from *discorhynchus* in having fewer anal rays (22-22) and a gibbosity on the chin.

Petrocephalus stuhlmanni Blgr.

1909. Boulenger, l.c., i, p. 56, fig. 41.

1916. *Id., ibid.*, iv, p. 156.

1917. Gilchrist and Thompson, *l.c.*, p. 562 (Lialui specimens recorded as *catostoma*).

There is a discrepancy in the number of scales around the caudal peduncle as given by Boulenger and by Gilchrist and Thompson: *catostoma* 16, *stuhlmanni* 12 according to the former, *vice versa* according to the latter authors.

The Leydsdorp specimen identified as *stuhlmanni* by Gilchrist and Thompson has 16 scales around the caudal peduncle, the Kafue specimens have 12. In Boulenger's key the Kafue specimens do in fact run down to *stuhlmanni*, whereas the Leydsdorp specimen, which has the same curious kink in the anal fin as shown in Boulenger's figure of *stuhlmanni*, runs down to *catostoma*. Who is correct?

It seems a little curious that a half-grown specimen from the Kafue River, whence Gilchrist and Thompson identified five specimens as *catostoma*, should be identified as *stuhlmanni* by Boulenger in 1916. All six specimens were collected at the same time and place by Mr. Drury (S. African Museum taxidermist attached to the Duke of Westminster's Expedition).

The South African Museum also possesses six specimens from Lialui, Upper Zambesi, 52-58 mm., and one from Mr. Eedes' collection from the Okovango River, 73 mm. (to end of middle caudal rays).

All these specimens have 12 scales around the caudal peduncle, and agree also in other respects; but not even the largest one has any sign of the irregular anal fin base.*

The Okovango specimen, as preserved in formalin, is very dark sepia, almost black on top of head and along dorsal profile, throat and breast pale greyish-white, an indistinct blackish bar across the end of the scaling on caudal peduncle (not on the rays).

FAMILY CHARACINIDAE.

Hydrocyon vittatus (Cast.).

1861. Castelnau, Mem. Poiss. Afr. Austr., p. 65 (*Hydrocinus v.*).

1913. Gilchrist and Thompson, *l.c.*, p. 338, fig. 12 (*lineatus*), and 1917, pp. 562, 578.

1939. Ricardo, Fish. Lake Rukwa and Bangweulu, pp. 21, 56 (*lineatus*).

This occasion is taken to note that the South African Tiger-fish should really be called by Castelnau's name: *vittatus*; and also to

* In *Gnathonemus macrolepidotus* this is a sexual character of the ♂. Ovigerous ♀♀ have a perfectly straight anal base.

draw attention to a somewhat remarkable outlying locality, Lake Sibayi in Zululand, where this fish is said to occur. The record appears in Mr. A. C. Harrison's Black-bass Report (1936, Fish. Mar. Surv. Investig., Rep. 7, p. 108) and rests on field observation only, no specimens having been submitted to Mr. Harrison.

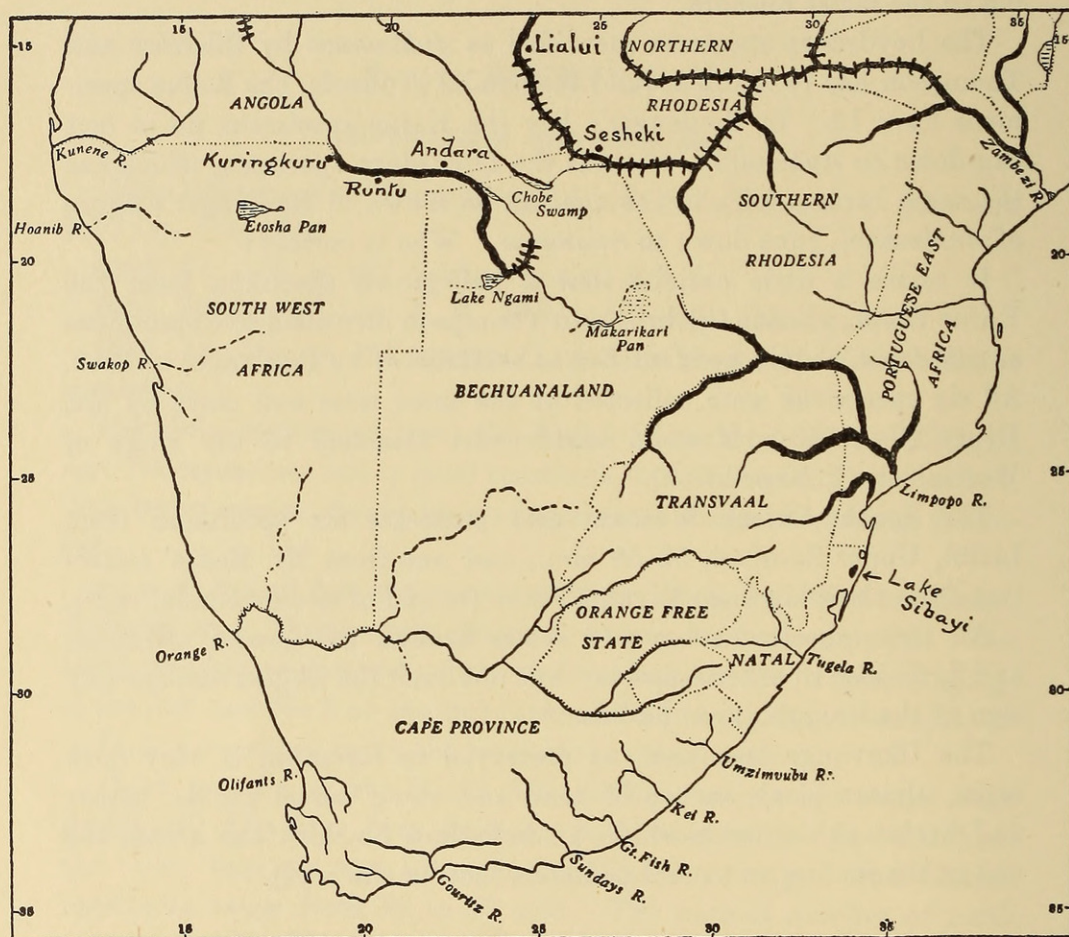


FIG. 1.—Distribution of: Tiger-fish (*Hydrocyon vittatus*), rivers thickened, also Lake Sibayi; Lesser Tiger-fish (*Hepsetus odoë*), rivers crossed.

Its absence from Lake Nyasa north of the Murchison Rapids on the Shiré River is also noteworthy (Worthington, Proc. Zool. Soc. Lond., 1933, i, pp. 286, 289; Bertram, Borley and Trewavas, Fish. Lake Nyasa, 1942, p. 18).

The map (fig. 1) shows the distribution of the Tiger-fish (*H. vittatus*) and the Lesser Tiger-fish (*Hepsetus* * *odoë*). Mr. Eedes caught the former, but not the latter, in the Okovango River. On the other

* Hubbs (Copeia, 1939, no. 3, p. 168) has resurrected Swainson's name *Hepsetus*, 1838, to take the place of *Hydrocyonoides* Castelnau.

hand, Pellegrin records the latter but not the former from the Cubango River.

Gen. ALESTES and MICRALESTES.

In the descriptions of the species of *Alestes* and *Micralestes* in his Catalogue, Boulenger did not refer to the sexual difference in the shape of the anal fin, although he figured the ♂ and ♀ of *M. acutidens*. In his *Fishes of the Nile* (1907), however, he specially mentions this feature in three species of *Alestes* (pp. 113, 118, 123) and in *M. acutidens* (p. 133). Gilchrist and Thompson also made no reference to sexual differences, but copied Boulenger's figures of *M. acutidens* without explanation, leaving the reader to guess that the two figures portrayed the two sexes.

No doubt the absence of a definite statement in Boulenger's Catalogue is responsible for Fowler instituting (1935) two "species" for the ♂♂ and ♀♀ of a lot of *Alestes* all caught together at the same place on the same day.

Whether sexual differences in the anal fin occur in all the species of these two genera is a point to investigate (see Trewavas, 1936, *Novit. Zool.*, xl, p. 65). It occurs in *Alestes imberi*, as I have been able to determine from specimens in the South African Museum. In some species there is sexual difference also in the dorsal fin.

Alestes lateralis Blgr.

1913. Gilchrist and Thompson, *l.c.*, p. 341, fig. 14.

1916. Boulenger, *l.c.*, iv, p. 179.

? 1925. Fowler, *Proc. Ac. Nat. Sci. Philad.*, lxxvii, p. 197.

1935. *Id.*, *Ann. Transvaal Mus.*, xvi, p. 257, fig. 3 (*thamalkanensis* = ♀).

1935. *Id.*, *ibid.*, p. 258, fig. 4 (*langi* = ♂).

1936. Pellegrin, *Arq. Mus. Bocage Lisbon*, vii, p. 49.

In the South African Museum there are 11 specimens (3 ♂♂, 8 ♀♀, 75–90 mm.) from Sesheki, Zambesi River. The depth of the body, especially in ♀♀, is frequently a little greater than the length of the head, as in Boulenger's figure.

Micralestes acutidens (Peters).

1913. Gilchrist and Thompson, *l.c.*, p. 342, fig. 15.

1913. *Id.*, *ibid.*, p. 343 (*humilis* non Blgr.).

The specimens from Maromba River, a tributary of the Zambesi

River, recorded by Gilchrist and Thompson (and quoted later by Boulenger, *l.c.*, iv, p. 184) as *humilis* are really *acutidens*.

M. humilis should be struck off the South African fauna-list.

In addition to Gilchrist and Thompson's material, there are in the South African Museum six specimens (three ♂♂, three ♀♀, 60–75 mm.) from the Victoria Falls (*ex* Rhodesian Mus.), and a series of thirty-two (3 ♂♂, the rest ♀♀ and juv., 27–60 mm.) from the Okovango River.

Gen. PETERSIUS Hilg.

1909. Boulenger, *l.c.*, i, p. 231, and 1916, *l.c.*, iv, p. 185.

1936. Trewavas, Novit. Zool., xl, p. 66, footnote.

Pellegrin (1936) has recorded the Upper Congo species *woosnami* Blgr. from Kukulakaze (Cunene system) and the Cubango River.

Herre (1936) described *P. barnardi* from near Beira. The latter constitutes the most southerly record of this genus.

Nannocharax multifasciatus Blgr.

1923. Boulenger, Ann. S. Afr. Mus., xiii, p. 437.

? 1933. Worthington, Ann. Mag. Nat. Hist. (10); xii, p. 40 (*minutus*).

1935. Fowler, Ann. Transvaal Mus. xvi, p. 260, figs. 6, 7 (*Distichodina stigmaturus*).

? 1938. Poll. Rev. Zool. Bot. Afr., xxx, p. 415, fig. 14 (*minutus* Worth).

A misprint in Boulenger's description may have been responsible for Fowler regarding this little fish as an undescribed species.

As printed the fin formula was given as D iii. 10; A. iii. 6; re-examination of the type shows that it is really D iii. 11, A ii. 9. I fail to find more than two anal spines, either in the type or in the new material from the Okovango River; except in the case of the 36 mm. specimen where either ii. 9 or iii. 8 can be reckoned.

The material shows the following features:—

Number of Specimens.	Length, mm.	D rays.	A rays.	l.l.	c.ped.	l/h.	h/e.	Interorb.	Snout.	
1 . .	19	11	8	37	12	$3\frac{1}{3}$	$2\frac{2}{3}$	< e	< e	No adipose fin.
2 . .	23	11	8	38–39	12	$3\frac{1}{3}$	$2\frac{2}{3}$	< e	< e	„
5 . .	26	11	8	39	12	$3\frac{1}{2}$	$2\frac{3}{4}$	< e	< e	„
1 . .	30	13	8	40	16	$3\frac{1}{2}$	$2\frac{4}{5}$	< e	< e	With adipose fin.
1 . .	36	12	9*	41	16	$3\frac{1}{2}$	3	i=e	< e	„
Type .	48	11	9	41	16	$3\frac{2}{4}$	$3\frac{1}{2}$	=	=	„
Fowler .	22–36	12	9–10	39–42	14 (in figure of 31 mm. specimen).	$3\frac{1}{3}$ – $3\frac{1}{2}$	$2\frac{2}{3}$ – $2\frac{3}{5}$	< e or=e	< e	„

* Might equally well be counted as iii. 8, instead of ii. 9.

Boulenger's type came from Sesheki, Zambesi River, Fowler's fourteen specimens from the Chobe River, 3 miles from Kasane. There are in the South African Museum nine specimens 23-36 mm., from the Okovango River, one, 19 mm., from the Linyanti River, and Boulenger's type.

Coloration as described by Fowler, the number of bars being variable. The black spot on the tail, however, is on the caudal rays, and there are no scales extending beyond it, contrary to Fowler's fig. 6; there may be one or two dark bars on the caudal behind the spot. There is a strong superficial likeness to a *Barilius*.

The most interesting feature of this series is the absence of the adipose fin in specimens up to 26 mm. in length. The adipose fin would appear to develop rather suddenly between the 26 and 30 mm. stages, and seems to be correlated with an increase in the number of scales around the caudal peduncle. The absence of the intermediate stage is very unfortunate. Although Fowler had specimens of 22 mm. upwards he makes no mention of this. Juveniles without the adipose fin bear an even closer resemblance to a *Barilius* than do the adults, but the shape of the mouth at once distinguishes them.

N. minutus Worth, from Lake Bangweolo, is closely related, if not actually synonymous.

Hemigrammocharax monardi Pelle, 1935 (see also 1936), from the Cubango River, is easily distinguished by its incomplete lateral line and predorsal scales 13 (instead of 15-16), although the coloration is very similar.

FAMILY CYPRINIDAE.

Labeo parvulus G. and T.

1913. Gilchrist and Thompson, *l.c.*, p. 353, fig. 22.

1916. Boulenger, *l.c.*, iv, p. 205, fig. 129.

1937. David and Poll, *Ann. Mus. Congo Belge, zool. ser. i, T. iii, fasc. 5*, p. 215 (Elisabethville).

One specimen, 60 mm. in length, from the Okovango River.

Head 4 in length of body, eye $1\frac{1}{2}$ in snout, 4 in head, $1\frac{2}{3}$ in inter-orbital width. Lat. line 34, predorsal 11, tr. $\frac{5}{8}$, 4 between lat. line and root of ventral, 14 around caudal peduncle. D iii. 10, 1st ray a little shorter than head.

Sharp horny tubercles on snout, some of them bifid. Gonads undeveloped.

For the time being this specimen must be identified as *parvulus*, although I suspect that *parvulus* itself is really the same as *cylindricus*.

The life-history of *cylindricus* should be worked out in one and the same locality.* As showing the reasonableness of the suggested synonymy, the following table has been drawn up from specimens from several localities:—

Total Length, mm.	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	D rays.	Tubercles, sex.
Okovango River, 60 .	4	4	$1\frac{1}{2}$	$1\frac{2}{3}$	34	14	10	Conical tubercles, gonads immature
Crocodile River,† 72 .	4	$4\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{3}{4}$	35	14	9	Conical tubercles gonads immature
Type of <i>parvulus</i> { 87 .	4	4	$1\frac{2}{3}$	$1\frac{3}{4}$	34	14	9	Scars. Immature.
120 .	4	$4\frac{1}{2}$	2	2	35	14-16	9-10	Scars. Immature.
Sabi River { 130 .	4	$4\frac{3}{4}$	$2\frac{1}{4}$	2	35	14-16	9	Scars few and feeble. ♂.
E. Transvaal { 150 .	4	5	$2\frac{1}{2}$	$2\frac{1}{2}$	35	14-16	9-10	Scars numerous. Immature. ?♀.
190 .	$4\frac{1}{4}$	6	3	$2\frac{3}{4}$	35	16	10	Scars and rounded warts numerous. Ovig. ♀.
Manzemtoti River, 220 .	$4\frac{1}{4}$	$6\frac{1}{4}$	3	3	36	18	10	Scars and rounded warts numerous. Ovig. ♀.
E. Transvaal								

† Eastern Transvaal, not the Crocodile River west of Pretoria.

In all these specimens the shape of the body agrees with Peters' figure, and both the depth of the body and the length of the 1st dorsal ray do not exceed the length of the head, or, in the case of the dorsal ray, only very slightly. The pectoral is longer than either the ventral or the anal.

In contrast to Boulenger's statement (1909, p. 330) that the tubercles on the snout are more developed in ♂ than in ♀ in *forskalii*, in the above specimens of *cylindricus* they are more numerous in the ♀♀.

There are, further, three specimens (245, 260, 275 mm., recorded by Gilchrist and Thompson as *cylindricus*) in the South African Museum from the western Transvaal and Zoutpansberg in the Limpopo River system, which agree except that the depth is greater ($1\frac{1}{4}$) than the head. Consequently the dorsal profile is steeper, and the characteristic *cylindrical* appearance is lost.

Probably these should be identified as *darlingi* Bilgr., which is recorded from the Letaba River, also in the Limpopo system. (The

* In Bertram, Borley and Trewavas, Fish. Lake Nyasa (1942, p. 43), some notes on the biology of *cylindricus* are given, but not from the taxonomic point of view.

localities for the type of *parvulus* and the specimens of *cylindricus* in the above table are in the Komati River system.)

Labeo forskalii Rüppell.

1913. Gilchrist and Thompson, *l.c.*, p. 348, fig. 19.

1917. Nicholls and Griscom, *Bull. Amer. Mus. Nat. Hist.*, xxxvii, p. 693 (Stanleyville).

Boulenger (1916, p. 205) considers that the Victoria Falls specimen, referred by Gilchrist and Thompson to *forskalii*, is probably *cylindricus*. With this opinion I cannot agree, that is if the South African Museum specimens of *cylindricus* are correctly identified. Both Peters and Boulenger refer to the close resemblance of these two species. There is, however, a great difference in the shape of the body between Peters' figure of a Zambesi *cylindricus* and Boulenger's figure of a Nile *forskalii*.

There are a number of specimens in the South African Museum from Transvaal localities which agree in body shape with Peters' *cylindricus*, and some of their main characters are set out below.

The Victoria Falls specimen, however, is quite different, with a steeper dorsal profile. It may not be the true *forskalii*, but it is certainly not the *cylindricus* of Peters. As there is a short series in the South African Museum I give a table of characters for comparison with those of *cylindricus*, including the two very fine and well-preserved specimens from the Okovango River.

In all of them from the youngest upwards both the depth of the body and the length of the 1st dorsal ray are greater than the length of the head, the 1st dorsal ray being in larger specimens considerably longer than head. Length of head $1\frac{1}{5}$ juv.— $1\frac{1}{3}$ adult in depth of body. In younger specimens the pectoral fin is subequal to the ventral fin and to the anal fin; it does not reach the ventral fin, and the ventral fin reaches only as far as the vent. In some of the larger ones the pectoral is slightly longer than the ventral and anal fins. In the two Okovango specimens they are subequal, but the pectoral reaches the ventral, and the ventral reaches to or almost to the anal (midway between vent and anal). The large Sesheki specimen is remarkable for having the pectoral $1\frac{1}{3}$ times as long as head, and extending beyond base of ventral; the latter is $1\frac{1}{5}$ times as long as head and extends beyond a knob-like excrescence which represents the absent anal fin.

All specimens with scales tr. $\frac{6}{7}$, and 4 between lat. line and root of ventral (5 if the scale covering the axillary scale be counted), predorsal 11–12.

Comparison of a long series from the very smallest upwards of the Zambesi form with a similar series of *forskalii* from the Nile might disclose differences; but for the time being there is no other course open but to identify all the above specimens as *forskalii*.

Total Length, mm.	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	1st D ray/H.	Warts, Sex.
Lialui { 112 .	4	5	2	$2\frac{1}{3}$	37	16	$1\frac{1}{5}$	} Scars on snout feeble. Immature.
Zambesi River { 120 .	4	5	2	$2\frac{1}{3}$	37-38	18	$1\frac{1}{4}$	
Victoria Falls 135 .	4	5	2	$2\frac{1}{3}$	38	18	$1\frac{1}{4}$	Scars numerous (guttured).
Sesheki 150 .	$4\frac{1}{4}$	5	2	$2\frac{1}{2}$	38	18	$1\frac{1}{3}$	Scars moderate. Immature.
Zambesi River								
Victoria Falls 200 .	$4\frac{1}{4}$	$5\frac{1}{2}$	$2\frac{2}{3}$	$2\frac{3}{4}$	39	16	$1\frac{1}{2}$	Rounded warts and scars. ?♂.
Sawmills (N. of Bulawayo) { 250	$4\frac{1}{4}$	$6\frac{4}{5}$	3	$3\frac{1}{2}$	38	16	$1\frac{1}{4}$	} Numerous sharp conical, bifid, or multifid tubercles spent ♀.
southern tributary of Zambesi River { 285	$4\frac{1}{4}$	7	3	$3\frac{1}{2}$	37	16	$1\frac{1}{4}$	
Sesheki 310 .	$4\frac{1}{4}$	7	3	$3\frac{2}{3}$	37	18	$1\frac{3}{4}$	Scars not numerous, rather feeble. ?♂.
Okovango River { 300	$4\frac{1}{4}$	7	3	4	38	18	$1\frac{3}{4}$	} Scars not numerous, rather feeble. ?♂ spent.
	$4\frac{1}{4}$	7	3	4	38	20	$1\frac{3}{4}$	

Gen. BARBUS Cuv.

The genus is divided according as the scales are longitudinally or radiately striate.

Of the first group, species with longitudinally striate scales, there are no specimens in Mr. Eedes' Okovango collection. Nevertheless it is interesting to set out the species which have been recorded from the Zambesi system, together with certain comments.

A. Last dorsal spine more or less enlarged *brucii* Blgr.
D iv. 9-10. Scales 28-30. $\frac{4-5}{4}$. 12 . (syn. *sector* and *cookei*)

B. Last dorsal spine not enlarged.

1. Dorsal high.

D iv. 9. 32-34. $\frac{5}{3}$. 12 "rubber-lip." 130 mm. *zambesensis* Peters

D iv. 9. 30-32. $\frac{4}{2}$. 12. "rubber-lip." 235 mm. *chilotes* Blgr.

D iv. 9. 29. $\frac{4}{2}$. (?12). "rubber-lip." 215 mm.

hypostomatus Pellegr.

D iv. 8. 30-31. $\frac{5}{3}$. 12. 320 mm. . . . *victoriae* Blgr.

D iii. 9. 32. $\frac{4}{2}$. 12. 390 mm. . . . *codringtonii* Blgr.

D iii. 9. 28. $\frac{4}{2}$. 12. 360 mm. . . . *altidorsalis* Blgr.

2. Dorsal moderate.

D iii. 8-9. 30-32. $\frac{4}{5}$. 12. 280 mm. *rhodesianus* Blgr.

3. Dorsal low.

D iii. 8. 33. $\frac{5}{8}$. 14. 420 mm. *fairbairnii* Blgr.

D iv. 9. 30. $\frac{4}{5}$. 12. 482 mm. *nasutus* G. and T.

Even at a first glance the list has a suspicious look. How many of these are really natural species, and how many merely "Museum species?" Three (*victoriae*, *fairbairnii*, *codringtonii*) came from the Victoria Falls (above and below), and one (*chilotes*) from two miles above the Falls. It seems rather a remarkable circumstance that the collector caught, or picked out from his catch, only a single specimen of each of the first three "species", and two of the last-mentioned. That is to say, four species were based on five specimens, and not one of them apparently identifiable with the already known *zambesensis* Peters. A fifth species (*altidorsalis*) was also based on a single specimen, from the Kafue River.

B. hypostomatus Pellegr., 1936, was described from a single specimen from the Cubango River (Upper Okovango), very like *chilotes*.

A further question: have no young specimens of any of these ever been caught and described? See p. 431: *inermis*.

B. brucii. I have elsewhere suggested,* that as fleshy lobelike lips ("rubber-lips") are not a specific character,† *sector* is probably a synonym of *brucii* (which latter has line precedence). Here again two species were founded on two specimens from the same locality. *B. cookei* G. and T. (one specimen) is in my opinion also synonymous.

I have examined a specimen from the Mazoe River, Mashonaland. This, in spite of its longitudinally striate scales, was first identified by Boulenger as *gurneyi* and returned to the South African Museum, then recorded by Gilchrist and Thompson as *bowkeri* (1913, p. 387). Actually it is a specimen of *brucii*. *B. dwaarsensis* G. and T., 1913, is probably also synonymous.

Of the second group, species with radiately striate scales, there are several representatives in Mr. Eedes' Okovango collection.

A synopsis of the relevant species is given, embodying the synonymy suggested below under the respective species.

I. No sensory ridges on head.

A. Last dorsal spine enlarged, not serrate. Two barbels. D rays

(7) 8. 1.1. 30-34. tr. $\frac{5}{8}$. c.ped. 14-16 *trimaculatus* Peters

* Barnard, Revision of F. W. Fishes S.W. Cape, Ann. S. Afr. Mus., xxxvi, p. 167, 1943.

† Worthington, 1929, Proc. Zool. Soc. Lond., p. 431.

- B. Last dorsal spine more or less enlarged, serrate.
1. Two barbels. D rays 7.
 Scales 33-36. $\frac{6-7}{3-4}$. 16-18. Ventral in front of
 dorsal, scales with few striae . . . *paludinosus* Peters
 35-37. $\frac{6}{3}$. 14. Ventral partly below dorsal, scales
 with numerous striae . . . *longicauda* Blgr.
 24-26. $\frac{4}{4}$. 12. Ventral arising in front of dorsal .
eutaenia Blgr (Zambesi)
 24-26. $\frac{4}{4}$. 12. Ventral arising below 3rd dorsal
 spine. . . *manicensis* Pellegr. (near Beira)
 2. One barbel. D rays 8 . . . *serrula* G. and T.
- C. Last dorsal spine not enlarged, not serrate.
1. Two barbels. Dorsal rays 8.
 a. Black spot at base of anal.
 26-29. $\frac{3}{2-3}$. 12. 3-7 black spots on sides .
barotseensis Pellegr.
 27-29 (31). $\frac{4}{4}$. 12. l.l. curved, distant from
 dark pigment stripe . . . *viviparus* Weber
 25-28. $\frac{4}{2}$. 12. l.l. straight, almost coincident
 with dark stripe . . . *thamalakanensis* Fowler
 21-24 (Fowler) 28-30 (Blgr.). $\frac{4}{2}$. 10. Vertical
 bars on sides . . . *barilioides* Blgr.
 - b. No black spot at base of anal.
 i. Scales with more than 10 striae.
 29-31. $\frac{4}{2}$. 12 (sometimes 9 or 10 D rays)
inermis Peters
 30-36. $\frac{5}{2}$. 14-16 . . . *macrurus* G. and T.
 - ii. Scales with less than 10 striae.
 26-27. $\frac{3}{2}$. 10. Posterior barbel $\frac{2}{3}$ eye .
radiatus Peters
 26-27 (? c.ped. and striae). 3-4 black spots
 on side. l.l. incomplete . . . *lujae* Blgr.
 30. $\frac{4}{2}$. 12. Both barbels longer than eye
lineomaculatus Blgr.
 30-33. $\frac{5}{3}$. 12. Dark lateral stripe, with
 or without spots. Depth of body greater
 than length of head . . . *unitaeniatus* Gnthr.
 2. One barbel . . . "afer" (Pellegrin 1920 name only) *
 3. No barbels, or very minute ones. D 8.
 Lat. line and dark pigment stripe coincident. No black
 spot at base of anal . . . *rogersi* Blgr.
 Lat. line curved, distant from dark stripe. A black
 spot at base of anal . . . juv. sp.? (Okovango)
- II. Sensory ridges or lines or pores on head (*Beirabarbus*) . . . *okavangoensis*

* Possibly a juvenile in the "single barbel" stage.

Barbus trimaculatus Peters.

1852. Peters, MB. Ak. Wiss. Berlin, p. 683.

1861. Castelnau, Mem. Poiss. Afr. Austr., p. 59 (*kurumanni*, original spelling).

1913. Gilchrist and Thompson, *l.c.*, p. 401, fig. 60.

1917. *Id.*, *ibid.*, p. 563.

1930. Lohberger, Zool. Anz., lxxxviii, p. 246, fig. (*poechii* Stndr.).

1930. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxii, p. 34 (Lake Victoria).

1933. Worthington, Proc. Zool. Soc., i, p. 304.

1935. Fowler, Ann. Transvaal Mus., xvi, p. 262.

1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 53.

From the examination of forty-two specimens (forty with 8, two with 7 dorsal rays) recently collected at Kuruman by Drs. Hesse and Boonstra and Mr. Thorne (of the South African Museum) it is obvious that Castelnau's species should be put into synonymy here. Castelnau said "la lèvre supérieure porte deux petits barbillons"; Boulenger (*l.c.*, ii, p. 144) has interpreted this as *one* barbel *on each side*, and has suggested that the species is allied to *trevelyani*. The strong dorsal spine and the locality (Orange River system) might have suggested *aeneus*, but the black spot at base of caudal would have excluded this latter species.

Kuruman was the only known locality for this species in the Orange River system, until the above-mentioned collectors captured four specimens in the Dry Hartz River, at Taungs in October 1939.

In the South African Museum there are the four specimens from the Kafue River recorded by Gilchrist and Thompson, one of them with 7 dorsal rays; one is an ovigerous ♀ 90 mm. in length. Also the faded Kuruman specimen (G. and T., 1917, p. 563) 70 mm. in length with 7 dorsal rays. Also two immature specimens from Lialui (one of them with 7 dorsal rays) and one from Sesheki, both on the Zambesi River.

Fifteen immature specimens, 50–63 mm. from the Okovango River. All of them with 8 dorsal rays, and 14 scales around caudal peduncle (except one which has only 12). The oval black spot at base of caudal is very distinct; a faint lateral stripe, with indications of the two spots (fore and aft the dorsal fin) in some specimens; the scales on upper half of body with darker edges; the lateral line below the lateral stripe is sometimes faintly indicated by pigmentation above and below the tubule on each scale.

Pellegrin records it from the Kunene River and the Cubango River, the latter being the upper (Angolan) portion of the Okovango River.

Peters described the fins as greenish, the lower ones more yellowish.

Fowler (1930) mentions a dark spot at base of anal in specimens from near Lake Victoria.

Barbus paludinosus Peters.

1913. Gilchrist and Thompson, *l.c.*, p. 404, fig. 62.
1913. *Id.*, *ibid.*, p. 408 (specimen from Wonderfontein, Transvaal, as *longicauda*).
1916. Boulenger, *l.c.*, iv, p. 251.
1917. Gilchrist and Thompson, *l.c.*, p. 563.
1930. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxii, p. 34.
1933. Worthington, Proc. Zool. Soc., i, p. 304.
1935. Fowler, Ann. Transvaal Mus., xvi, p. 263.
1935. *Id.*, *ibid.*, p. 265, fig. 9 (*tsotsorogensis*).
1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 53.
1936. Trewavas, Novit. Zool., xl, p. 66.
1939. Ricardo, Fish. Lake Rukwa and Bangweulu, p. 23.
1943. Barnard, Ann. S. Afr. Mus., xxxvi, p. 171, fig. 14 *a, b*, (growth-changes).

The dusky coloration, composed of minute dots and specks which are often (especially along the middle of the sides) vertically oval in shape, is characteristic of specimens preserved in formalin. In specimens preserved in alcohol the silvery coloration often renders the pigmentation less conspicuous.

Two specimens from the Okovango River, preserved in formalin, were on arrival at the Museum olivaceous above, dorsal and caudal fins faintly pinkish, pectoral, ventral, and anal slightly yellowish.

Specimens from the Orange River, preserved in alcohol, were silvery, more or less greyish above and along middle of sides, the fins very faintly yellowish.

Peters gave the colour as green, silvery on sides, fins red. Probably rosy or salmon would have been a better term than "red."

I have personally examined specimens of *tsotsorogensis*, kindly loaned by the Transvaal Museum. The identity is obvious on direct comparison.

B. longicauda Blgr. (*gibbosus* Peters, non C. and V.) differs in having rather numerous striae on the scales instead of comparatively few (*cf.* Peters, Reise Mossamb., pl. xi, figs. 1, *paludinosus* and 2, *gibbosus*),

and the ventral fins are not wholly in advance of the dorsal fin. The Transvaal specimen recorded by Gilchrist and Thompson is *paludinosus*, not *longicauda*.

Barbus barotseensis Pellegr.

Fig. 2.

1920. Pellegrin. Bull. Soc. zool. Fr., xlv, p. 149 (*radiatus* var. *barotseensis*).

Differs from *radiatus* Peters (Tete, Lower Zambesi) in having three spots along the sides, and one at base of anal fin; and in having a

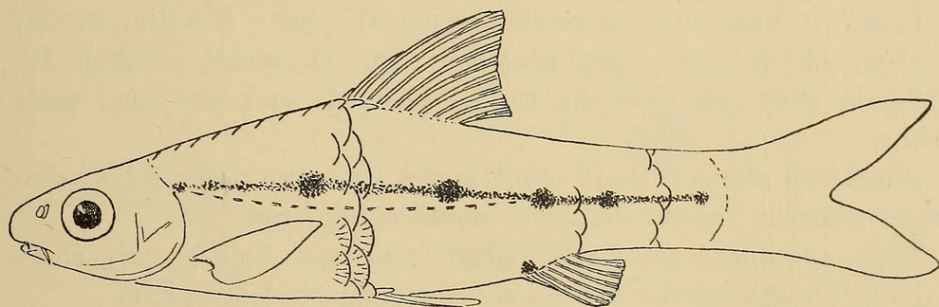


FIG. 2.—*Barbus barotseensis* Pellegr. 10th, 20th, and 25th scales in lat. line indicated.

shorter pectoral. Pellegrin does not suggest it, but the latter feature may be merely sexual.

	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	Striae.	g.r.	Barbels.
32 mm.	$3\frac{1}{4}$	$2\frac{3}{4}$	e > s	e > i	27	12	3-4	1 + 5	Anterior $\frac{1}{6}$ eye. Posterior $\frac{1}{4}$ eye.
35 "	$3\frac{1}{3}$	$2\frac{3}{4}$	"	"	28	12			
40 "	$3\frac{1}{2}$	$2\frac{3}{4}$	"	"	28	12			
45 "	$3\frac{2}{3}$	3	"	e = i	28	12	5-6		Anterior $\frac{1}{4}$ eye. Posterior $\frac{1}{3}$ eye.
57 "	$3\frac{3}{4}$	3	"	"	28	12	6-7 (8)	1 + 6 (7)	Anterior $\frac{1}{4}$ eye. Posterior $\frac{2}{5}$ eye.

A series of thirteen specimens, 32-57 mm. in length, from the Okovango River seem to be referable in this species. They have 3 or 4 to 6 or 7 black spots more or less connected by a faint lateral stripe. Unlike *lineomaculatus*, where only the spot at base of caudal is on the lateral line, in these specimens the last 2 or 3, *i.e.* one or two situate above the anal fin and on caudal peduncle, as well as the one at base of caudal are on the lateral line; *cf.* figure of *atromaculatus* N. and G.,

1917, and Fowler, 1930, fig. 6 ("*lujae*" *). Moreover, there is a conspicuous black spot at base of anal fin, which is not present in *lineomaculatus*.

On arrival at the Museum (in formalin) the fins were colourless.

The scales show 4 radiating striae in the smallest, and not more than 8 in the largest specimen. Both barbels are very short, in the largest specimen the posterior barbel not quite $\frac{1}{2}$ eye-diameter, the anterior one about $\frac{1}{4}$ eye. By this feature these specimens are distinguished from *atromaculatus*, *lineomaculatus*, *lujae*, *tetrastigma*.

The eye is distinctly larger than in equal-sized specimens of *lineomaculatus*. Pupil $\frac{1}{2}$ eye-diameter.

D iii. 8. Ventral spine below 3rd dorsal spine. Lat. line 27-28; 3 above l.l., 2 below; predorsal 8-9; around caudal peduncle 12. Pellegrin does not give the caudal peduncle and predorsal scale counts.

Gill-rakers about 6 short blunt knobs on lower part of 1st arch. Snout rounded, shorter than eye, mouth sub-inferior.

These specimens are distinguished from *lujae* by the very short barbels, the sub-inferior mouth, and the complete lateral line.

B. barotseensis was first described (as a variety of *radiatus*) from Lialui, Upper Zambesi River. It was not reported by Pellegrin from the Cubango (Upper Okovango River) in 1936.

Barbus viviparus Weber.

Fig. 3.

1913. Gilchrist and Thompson, *l.c.*, p. 421, fig. 79.†

cf. 1935. Fowler, Ann. Transvaal Mus., xvi, p. 266, fig. 10 (*bifrenatus*).

1936. Pellegrin. Arq. Mus. Bocage Lisbon, vii, p. 55 (*bifrenatus*).

1943. Barnard, Ann. S. Afr. Mus., xxxvi, p. 218 (notes on alleged viviparity).

Fowler mentioned differences in coloration between *bifrenatus* and *rogersi*, but did not specially mention that the latter has no barbels or only a minute one on each side.

Pellegrin records *bifrenatus* from the Cubango River, Angola (upper reaches of the Okovango River).

* David and Poll (1937) consider that Fowler's 1930 figures represent *lineomaculatus*; one must assume that they consider the black spot at base of anal (present in *lujae* but not in *lineomaculatus*) as of no specific importance. They also do not agree that *lujae* and *lineomaculatus* are synonymous.

† P. 421, line 6 from bottom, for "but" read "not".

As a matter of fact *bifrenatus* is so extraordinarily like *viviparus* that I think the two should be united.

I have compared paratypes of *bifrenatus* with cotypes of *viviparus*; I have also examined the Livingstone specimen (referred by G. and T. to *viviparus*) and three specimens from the Saib River, eastern Transvaal.

From the descriptions it is not easy to reconcile the differences in the numbers of scales transversely, unless the points between

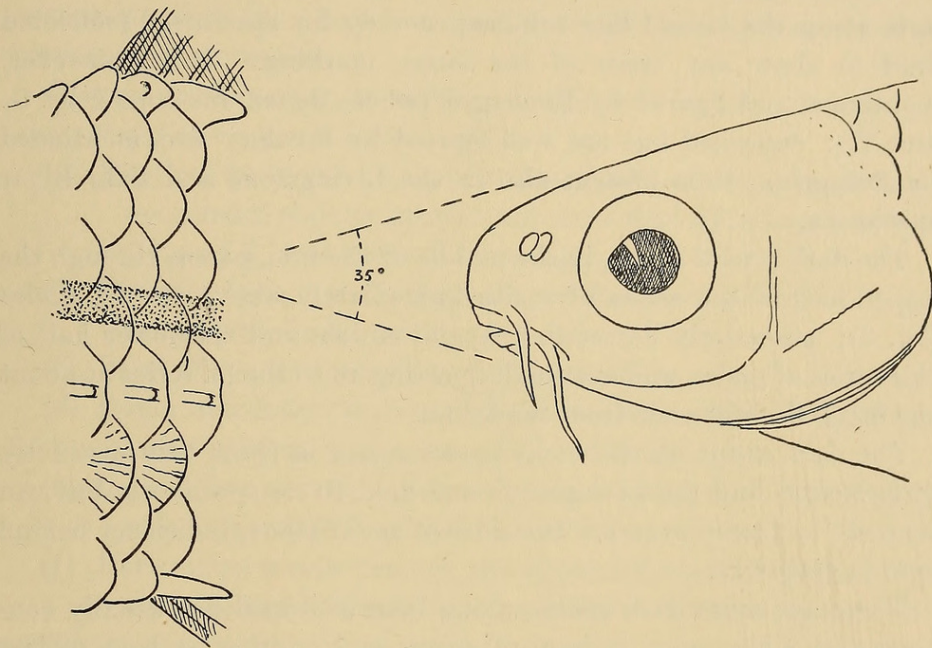


FIG. 3.—*Barbus viviparus-bifrenatus*. Scaling between dorsal and ventral fins to illustrate method of counting, and position of the dark lateral stripe in relation to the lateral line. Head to illustrate features mentioned in text.

which the count is taken are definitely stated. Weber gave: "1. tr. 5.1.4 (V)"; Boulenger: $\frac{4\frac{1}{2}}{4\frac{1}{2}}$, 3 between l.l. and ventral"; Gilchrist and Thompson: $\frac{4\frac{1}{2}}{4\frac{1}{2}}$, $2\frac{1}{2}$ between l.l. and ventral"; Fowler: "6 above 3 below"; Pellegrin: $\frac{4\frac{1}{2}}{4\frac{1}{2}}$. Boulenger's figure shows 4 between l.l. and dorsal, 3 between l.l. and ventral; Fowler's figure of the young agrees with this, but his figure of the type shows 3 above and 3 below the lat. line.

As frequently happens, such discrepancies, evident enough "on paper", disappear when the actual specimens are compared.

In all the above mentioned specimens there are 4 scales between the l.l. and the base of the dorsal, *not* counting the pre-dorsal scale in front of the dorsal spine, or the elongate scales along the base of dorsal; and 3 between the l.l. and ventral spine, including the scale which lies immediately above base of spine and from behind which the axillary scale projects, or 2 if this and the axillary scale be excluded (fig. 3).

Weber mentioned the lateral stripe, but not the double line of dots along the lateral line tubules; nor do his specimens (collected 1894-5) show any trace of the latter marking. It is, however, mentioned and figured by Boulenger (whose figure was copied by G. and T.); described but not well figured by Fowler; and mentioned by Pellegrin. It is present also in the Livingstone and Sabi River specimens.

The dark lateral stripe, in the middle of the side, passes through the upper half of the series of scales immediately above the l.l. scales (fig. 3); posteriorly descending to the middle and the lower half of this series of scales, and eventually passing on to the l.l. series at about the 8th (7th-9th) scale from caudal fin.

The dark stripe on the snout passes round in front very distinctly in *bifrenatus* and the Livingstone and Sabi River specimens, but can scarcely be traced even on the sides of snout (though distinct behind eye) in *viviparus*.

There are some dark specks along base of dorsal fin, usually concentrated into a spot at base of spines and another at base of last rays, sometimes a third in the middle.

In the Okovango specimen a black medio-ventral streak between anal and caudal on the caudal peduncle, and a fainter medio-dorsal stripe.

There are 12 scales around the caudal peduncle: in 18 mm. *bifrenatus* and 20 mm. *viviparus*, and larger specimens.

The position of the base of the ventral spine is in the vertical from the dorsal spines; Fowler's figure of the type of *bifrenatus* shows it distinctly in advance; but it is not in advance in the five paratypes I have seen.

After thorough comparison, the only differences I can find are: a very slightly larger eye and a few more striae on the scales in the Sabi and Zambesi specimens than in *viviparus* from Natal (specimens of equal size compared, see table). In *viviparus* there are 5-7 striae (on the exposed field), in *bifrenatus* 8-10 (not counting incomplete intercalaries). These differences are scarcely enough to justify two

species, especially when other small species of *Barbus* (e.g. *trimaculatus*, *paludinosus*) seem to have an equally wide range in the *tropical* and (eastern) *subtropical* areas.

In the largest paratype of *bifrenatus* seen, 30 mm., the eye is greater than length of snout (as seen in profile); Fowler's statement that it is subequal to the snout would be correct if measurement is taken on the curve to tip of snout.

As I have elsewhere pointed out, there are strong reasons for suspecting that the alleged viviparity of this species was based on erroneous observations.

Diagnostic characters, in addition to the more usually given specific characters, of *viviparus-bifrenatus*:—

- (a) Depth of body at least equal to length of head, usually (in larger specimens) slightly greater, not more than $3\frac{2}{3}$ in length of body (G. and T.'s measurement wrong).
- (b) Distance from top of gill opening to the dorsal profile at 1st pre-dorsal scale subequal to eye.
- (c) Pupil of eye not exceeding $\frac{1}{2}$ -eye diameter.
- (d) Upper and lower profiles of head if continued in straight lines meeting at an angle of approximately 35° .
- (e) Lateral line curved downwards and meeting dark lateral stripe only in vertical from end of anal base.
- (f) Dark stripe passes through the upper halves of the scales above the lat. line (*i.e.* where the l.l. and the dark stripe are separate).

		L/H.	H/E.	S/E.	L/E.	Barbels.	
<i>bifrenatus</i>	(2 spec.) 18 mm.	3½	2¾	s < e	subequal	Anterior a mere point. Posterior ½ eye.	
paratypes	21 "	3½	2⅘	s < e	"	Anterior ¼ eye. Posterior ⅔ eye.	
	(2 spec.) 30 "	3½	3	s < e	"	Anterior ⅔ eye. Posterior = eye.	
Sabi River	35 "	3½	3	s < e	"	Anterior ⅔ eye. Posterior = eye.	
	36 "	3½	3	s < e	"	(Mutilated).	
	43 "	4	3	s < e	"	Anterior ½ eye. Posterior ¾ eye (whole specimen shrunk).	
Okovango River	37 "	3⅔	3	s < e	"	Anterior ⅔ eye. Posterior = eye.	
Livingstone	40 "	4	3	s < e	"	Anterior ¾ eye. Posterior slightly > eye.	
Cotypes <i>viviparus</i>	Verulam	20 "	3½	2½		Anterior a mere point. Posterior ½ eye.	
		25 "	3¾	3	s < e	"	Anterior ¼ eye. Posterior ⅔ eye.
		35 "	4	3⅕	s < e	"	Anterior ⅓ eye. Posterior ⅘ eye.
		40 "	4	3¼	s < e	1¼	Anterior ½ eye. Posterior = eye.
		45 "	4	3½	s < e	1½	Anterior ⅔ eye. Posterior > eye.
	50 "	4	3¾	s = e	1½	Anterior ⅘ eye. Posterior > eye.	
	Isipingo	59 "	4	3¾	s = e	1½	Anterior = eye. Posterior > eye.

Barbus thamalakanensis Fowler.

1935. Fowler, Ann. Transvaal Mus., xvi, p. 263, fig. 8.

1935. *Id.*, *ibid.*, p. 267, fig. 11 (*fitzsimonsi*).

I have seen the type of the former, and nine paratypes (Transv. Mus. No. 15251, Kasane, 12–20 mm.) of the latter. The former is in poor condition, as Fowler noted (tip of dorsal spine broken off), and many of the scales are rubbed off. There are several discrepancies between the descriptions and figures of these two “species”; *fitzsimonsi* is said to have “one pair of barbels at maxillary end”, the figure indicates that there are two barbels on each side (and only 6 rays in the dorsal fin).

I have therefore carefully examined these specimens.

As regards *thamalakanensis*: the anterior barbel is longer, $\frac{1}{3}$ the posterior; l.l. with 27 on left, 25 on right side, all told, pre-dorsal 11 (in figure about 30 and 13 respectively), 12 around caudal peduncle; ventral axillary scale present; the l.l. nearly straight, the tubules in the middle of the side touching the lower margin of the lateral stripe. Pupil $\frac{1}{2}$ eye-diameter. Distance from top of gill opening to dorsal profile at 1st pre-dorsal scale less than eye-diameter. Dorsal and ventral profiles of head, if continued, subtending an angle greater than 30°.

The specimen is a ♂, but not fully ripe, 36 mm. in length to end of middle caudal rays.

The specimens of *fitzsimonsi* are obviously juveniles. They display all the features of *thamalakanensis*: where the full scaling remains the number of l.l. tubules is 27–28 (in one case only 26), pre-dorsal 10–11, 12 around caudal peduncle; l.l. nearly straight, and touching (in middle of side) the lower margin of lateral stripe; both anterior and posterior barbels present in specimens from about 16 mm. upwards. Four clear rows of scales above l.l. and 2 clear rows below, but if the small scales at base of dorsal and ventral spines be counted, the numbers are 5 and 3. In this respect the figure of *thamalakanensis* is correct, that of *fitzsimonsi* incorrect.

I have no doubts on the above synonymy, but the question remains whether *thamalakanensis* itself is a valid species.

	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	Striae.	g.r.	Barbels.
<i>fitzsimonsi</i>									
13 mm.	3 $\frac{1}{4}$	3	e > s	e > i	Scaled, but many lost.			0 + 3	Posterior $\frac{1}{4}$ eye.
14 „	3 $\frac{1}{4}$	3	„	„					Anterior a mere point.
Kasane	16 „	3 $\frac{1}{3}$	3	„	Count uncertain.				Posterior $\frac{1}{4}$ eye.
paratypes	18 „	3 $\frac{2}{5}$	3	„					Anterior a mere point.
	19 „	3 $\frac{1}{2}$	3	„	27	12	4-5		Posterior $\frac{1}{3}$ eye.
	20 „	3 $\frac{1}{2}$	3	„	27	12		0 + 3	Anterior $\frac{1}{5}$ eye. Pos- terior $\frac{2}{3}$ eye.
	22 „	3 $\frac{1}{2}$	3	„	27-28	12	5	1 + 3	Anterior $\frac{1}{4}$ eye. Pos- terior $\frac{3}{4}$ eye.
<i>thamalakanensis</i> type 36 „	3 $\frac{3}{4}$	3	„	„	27 left 25 right	12	7	1 + 4	Anterior $\frac{1}{4}$ eye. Pos- terior = eye.

Barbus inermis Peters.

1911. Boulenger, *l.c.*, ii, p. 153, fig. 129 (copy from Peters) (Limpopo system).

1913. Gilchrist and Thompson, *l.c.*, p. 426, fig. 84 (copy from Peters).

1937. David and Poll, Ann. Mus. Congo Belge, zool. ser., 1, T. iii, fasc. 5, p. 218 (Elizabethville).

Boulenger (p. 153, footnote) says the scales of this species may be regarded as a link between those with longitudinal striae and those with radiate striae. Peter's figure (1862, pl. xi, fig. 3) of the scale shows fourteen feebly radiating striae (largest specimen 80 mm.). Boulenger records "ad. and hgr." up to 100 mm., but one does not know whether he actually examined the gonads.

The point of these remarks is that the scales of *inermis* bear a strong resemblance to those found in juveniles of species with longitudinally striate scales. A further noteworthy feature is the shape of the anal fin. This elongate shape, as I have mentioned in another paper,* seems to be found mostly in species with longitudinally striate scales.

It is, moreover, a remarkable fact that no young specimens of any of the big Zambesi *Barbus* (with longitudinally striate scales) seem to have been recorded. It is therefore urgently desirable that the *life-histories* of the fishes of this river be investigated.

* Ann. S. Afr. Mus., xxxvi, p. 143, 1943.

I do not actually claim *inermis* as the young of a larger species.

There is a 55 mm. specimen from the Victoria Falls in the South African Museum. It is not in very good condition, but agrees well with Peters's description. The anal fin is of the same rather elongate shape, but the dorsal fin has only 3 spines and 8 rays. Lat. line 28; 4 clear scales above l.l., and 2 below; pre-dorsal 10; caudal peduncle 12. Striae numerous and feebly radiating.

The barbels are longer than in Peters's figure and Boulenger's description: the anterior one is almost equal to the eye, and the posterior one a little longer than eye. Gonads immature.

Out of four specimens Peters found three with D iv. 9 and 4 scales between lat. lin. and dorsal, and one specimen with D iv. 8 and 5 scales above l.l. The question may be asked whether examples of two species have not been mixed together. David and Poll's specimens had 9-10 dorsal rays, which increases the suspicion that they may be the young of a large species with longitudinally striate scales.

The anomalous specimen mentioned by Peters may be the same as the Okovango specimens assigned to *macrurus* (*infra*).

But much more material is required. It is useless to consider single or only a few specimens.

Barbus cf. *inermis* Peters, and *macrurus* G. and T.

Fig. 4.

1913. Gilchrist and Thompson, *l.c.*, p. 425, fig. 83.

1916. Boulenger, *l.c.*, iv, p. 263, fig. 161.

Twenty-seven specimens, 38-75 mm. in length, from the Okovango River appear at first sight somewhat like *unitaeniatus* (Angola and Cubango River), but are much more slender and have more scales around the caudal peduncle.

It is always risky to identify specimens from one river system with species described from another system without actual comparison. In the present instance a direct comparison with the type material of *macrurus* (Dwars River, Transvaal, Limpopo system) is possible.

This type material now comprises (in South African Museum) only five specimens from the Dwars River, 66-80 mm. in length (Thompson gave the standard length 60-74 mm., *i.e.* excluding caudal fin). The shape of the snout in Gilchrist and Thompson's figure is due to shrinkage.

Okovango specimens: depth of body less than length of head, $4\frac{1}{3}$ - $4\frac{1}{2}$ (largest) in length of body (excl. caudal). Mouth sub-inferior.

D iii. 8. A. iii. 5. Predorsal scales 10-11, 5 clear rows above lat. line, 2 below. See also table, and following features:—

- (a) Depth of body less than length of head.
- (b) Distance from top of gill opening to dorsal profile at 1st pre-dorsal scale less than eye-diameter.
- (c) Pupil of eye (slightly) exceeding $\frac{1}{2}$ eye-diameter.
- (d) Upper and lower profiles of head, if produced straight, subtending an angle of about 30° (juv. somewhat less than 30° , adult scarcely exceeding 30°).
- (e) Lat. line curved, meeting dark lateral stripe above middle or end of anal base.
- (f) Dark lateral stripe along middle of row of scales immediately above lat. line (where latter and the stripe are separate).

Except that the caudal peduncle tends to be a very little longer in *macrurus* than in the Okovango specimens, the lat. line scales in the larger *macrurus* slightly more numerous, and the striae on the scales slightly fewer, I find no differences. For the present the Okovango specimens may be assigned to *macrurus*, with the proviso that when full series of all stages from both localities are available, differences in the earlier growth-stages may possibly be found.

As in several other species, there are actually four dorsal spines, but the first is so minute, and not visible externally, that it may be ignored in practice (cf. my remarks in Ann. S. Afr. Mus., xxxvi, p. 142). On the other hand the small 1st spine in *inermis* is clearly illustrated in Peter's figure.

Boulenger (*l.c.*, p. 264) considered that this species might be the same as *labialis*. Unfortunately the type of the latter is not in the South African Museum, so I am unable to check G. and T.'s description.

		L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	Striae	g.r.	Barbels, and Sex.
Okovango River	38 mm.	$3\frac{1}{2}$	3	e > s	e=i	29-30	14	5-6	1+3	Both well developed. Anterior $\frac{2}{3}$ eye.
	45 "	$3\frac{1}{2}$	3	"	"	29-30	14	8		
	65 "	$3\frac{3}{4}$	$3\frac{1}{2}$	e=s	$1\frac{1}{4}$	31-32	16	10-12	2+4 or 5	Anterior $\frac{3}{4}$ eye. Posterior=eye.
	75 "	4	$3\frac{1}{2}$	"	$1\frac{1}{4}$	32-33	16	14		Anterior $\frac{3}{4}$ eye. Posterior=eye.
<i>macrurus</i> type material, Dwars River	66 "	$3\frac{4}{5}$	$3\frac{1}{2}$	"	$1\frac{1}{4}$	33	16	8	2+5	Anterior $\frac{3}{4}$ eye. Posterior=eye.
	68 "	$3\frac{4}{5}$	$3\frac{1}{2}$	"	$1\frac{1}{4}$	33	16			♂.
	(2) 75 "	4	$3\frac{2}{3}$	"	$1\frac{1}{3}$	33-35	16	8-10		
	80 "	4	$3\frac{2}{3}$	"	$1\frac{1}{3}$	36	16	10-12	2+5	Spent ♀. Anterior=eye. Posterior $1\frac{1}{4}$ eye.

In the Okovango specimens the dark lateral stripe varies in width and intensity; sometimes continuous, sometimes appearing as if broken up into longitudinal streaks, varying in length. Usually a dark spot at base of caudal, but not wider than the lateral stripe. The lateral line tubules anteriorly where the lat. line is separate from the dark stripe indicated more or less distinctly by pairs of dark marks.

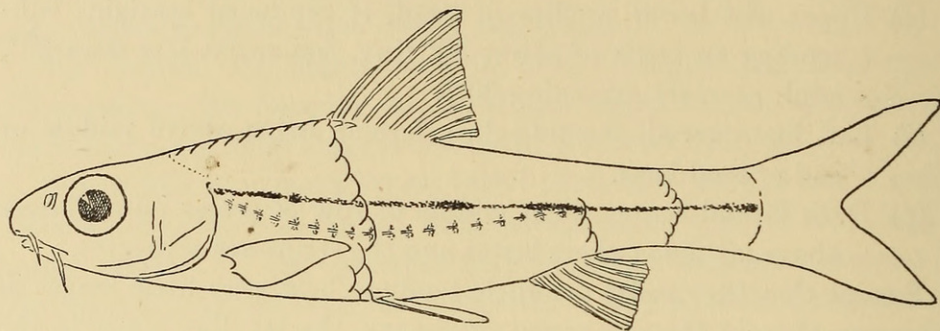


FIG. 4.—*Barbus* cf. *inermis* Peters and *macrurus* G. and T. Okovango specimen, 10th, 20th, and 25th scales in lat. line indicated.

No black spot at base of anal fin. Coloration in *macrurus* similar (so far as it remains; the dark stripe in G. and T.'s figure is wider than in the five specimens at hand.

Barbus lineomaculatus Blgr.

1913. Gilchrist and Thompson, *l.c.*, p. 420, fig. 78, and 1917, p. 563.

1916. Boulenger, *l.c.*, iv, p. 266.

1936. Pellegrin, *Arq. Mus. Bocage Lisbon*, vii, p. 55.

1936. Trewavas, *Novit. Zoolog.*, xl, p. 69.

1937. David and Poll, *Ann. Mus. Congo Belge, zool. ser.*, 1, T. iii, fasc. 5, p. 219, fig. 13a.

The specimens recorded by Gilchrist and Thompson conform with Boulenger's description; also one from Spring Vale, Matoppos, Rhodesia (? whether the latter, and also Insiza, are in the Zambesi or the Limpopo system). Boulenger's 1916 locality is Solwezi on the head-waters of the Kafue River.*

Both barbels at least as long as eye-diameter. All but the last of the lateral spots are above the lateral line tubules; no dark spot at base of anal fin. About 12 radiating striae on exposed surface of scale in a specimen 50 mm. long.

* Boulenger in Gilchrist and Thompson (*l.c.* 1917, p. 578) says Solwezi is on the "Congo watershed". Actually it is on the south side of the watershed, in the Kafue-Zambesi drainage system.

Fowler (1930, *l.c.*, p. 36, and 1935, *l.c.*, p. 266) unites *lineomaculatus* Blgr., 1903, with *lujae* Blgr., 1913; if they are synonymous surely the 1903 name must be accepted.

Neither David and Poll nor myself consider that these two are synonymous. Nor am I altogether satisfied that the Rhodesian *lineomaculatus* is the same as the East African (type locality), but as Boulenger has compared actual specimens, his opinion is accepted here. In addition to the lat. line (complete or incomplete respectively) another difference between *lineomaculatus* and *lujae* is the position of the mouth; although one wonders whether, in some cases at least, this may not be due to different methods of preservation (*cf.* the figure of *atromaculatus* N. and G., 1917, with those of "*lujae*" given by Fowler, 1930).

Pellegrin records it from the Cubango (Kubango) River, Angola; and Trewavas from the upper reaches of the Kunene River.

Barbus juv. sp.?

Fig. 5.

Twenty specimens, 22–45 mm. in length, from the Okovango River.

Colour (as preserved in formalin): dusky above, a black lateral stripe around front of snout and continued through eye to caudal, rather sharply defined, sometimes with slight enlargement (but scarcely forming a spot) at end of caudal peduncle; lateral line where it is separate from the stripe marked by a double row of black specks; a black spot at base of anal, and usually one at base of dorsal spines; a thin medio-ventral stripe on caudal peduncle, also a less conspicuous medio-dorsal one, also sometimes a predorsal stripe with or without one or two spots on it.

D iii. 8 (one specimen with 7 rays). A iii. 5. Predorsal 10–11; 4 clear rows between dorsal spine and l.l., and 2 clear rows between l.l. and ventral spine (*i.e.* excluding the smaller scales at bases of the spines).

Other features are given in the following table, and the diagnostic features, which indicate the differences between this species and *viviparus*.

- (a) Depth of body less than length of head, or in larger specimens nearly equal, but *not greater than* $4-4\frac{1}{2}$ in length of body.
- (b) Distance from top of gill opening to dorsal profile at 1st predorsal scale less than eye-diameter.

- (c) Pupil of eye exceeding $\frac{1}{2}$ eye-diameter.
- (d) Upper and lower profiles of head, if continued straight, meeting at an angle less than 30° .
- (e) Lateral line nearly straight, meeting the dark lateral stripe at vertical from anterior end or middle of anal base.
- (f) The dark lateral stripe more diffuse or broader than in *viviparus*, passing through centre and lower half of scales immediately above the l.l., and sometimes embracing the top portions of the l.l. scales (*i.e.* where the stripe and the l.l. are separate).

	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	Striae.	g.r.	Barbels.
22 mm.	$3\frac{1}{2}$	$2\frac{2}{3}$	$e > s$	$e > i$	28	12		0 + 4	None.
23 "	$3\frac{1}{2}$	$2\frac{2}{3}$	"	"	29	12	4-5		Posterior a mere point.
28 "	$3\frac{1}{2}$	$2\frac{3}{4}$	"	"	29	12			"
30 "	$3\frac{1}{2}$	$2\frac{3}{4}$	"	"	29-30	12	4-6	0 or 1 + 4	"
37 "	$3\frac{3}{4}$	$2\frac{3}{4}$	"	"	29-31	12			"
40 "	$3\frac{4}{5}$	3	"	$e = i$	29-30	12	4-6		Posterior $\frac{1}{8}$ - $\frac{1}{8}$ eye.
45 "	4	3	"	"	29	12		1 = 4 or 5	Anterior a mere point. Posterior $\frac{1}{5}$ eye.

These specimens cannot be assigned to *viviparus-bifrenatus* because, in addition to the above reasons, the barbels do not develop at all

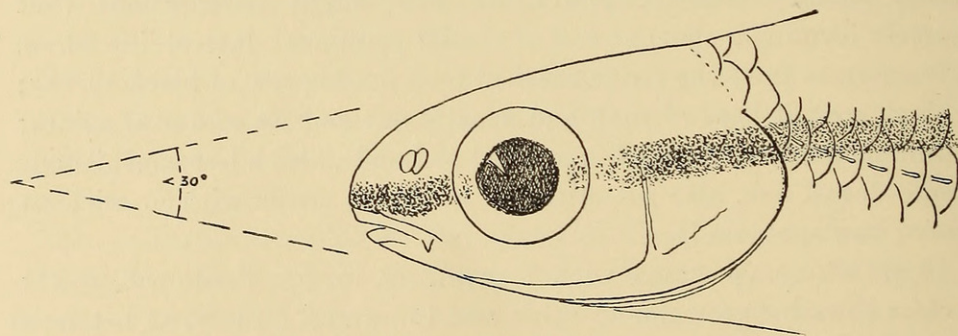


FIG. 5.—*Barbus* sp. juv. Okovango.

until a later stage (size), and even in the longest the anterior one is a mere point (easily overlooked), whereas in an equal sized *viviparus-bifrenatus* it is at least $\frac{1}{2}$ the eye-diameter.

They might have been assigned to *thamalakanensis*, but I have shown above, by re-examination of the type, that the figure of that species is incorrect.

They are the juveniles (gonads in the larger specimens undeveloped)

of some larger species, but much more material is required before they can be correctly identified.

Barbus (Beirabarus) okavangoensis Brnrd.

Figs. 6a, 7.

1941. Barnard, Ann. Mag. Nat. Hist. (xi), 8, p. 470.

Seventy-five specimens, 27–65 mm. in length, from the Okovango River.

Depth of body *not exceeding* length of head *at any stage*, less than head in young, equal to in adults. Predorsal profile behind head not strongly elevated. Snout rounded, shorter than eye, but in some of the largest specimens subequal to it. Mouth inferior. Barbels very small, even in the largest specimens, not exceeding $\frac{1}{3}$ eye, the posterior one only very little longer than the anterior one (*i.e.* shorter than in typical *palustris*). Gill-rakers 2+5 or 6 on 1st arch, short, knob-like, the lower ones very feeble.

D iii. 8. A iii. 5. Pectoral reaching to or almost to ventrals in both sexes. Scales: l.l. 26–28, predorsal (8–)9, 3 between dorsal and l.l., 2 between l.l. and ventral spine (as in *palustris*), 12 around caudal peduncle. Lateral line *straight* from beginning to end. Scales with 4–6 striae on exposed field in smaller specimens, 6–8 in largest.

Colour of the Okovango specimens after preservation in formalin: each scale above lat. line, and, less conspicuously, the two series below it, with a greyish lunate or arrow-head shaped spot; a blackish line from tip of snout to base of caudal rays, straight and *exactly following* the course of the lat. line tubules; dorsal and caudal fins salmon, anal fin also usually tinged with pink (cf. *aurantiacus*), front edge and tip of dorsal, and sometimes hind margin (cf. *rogersi*), more or less greyish.

A peculiarity of this species is the straightness of the lateral line, in consequence of which the series of tubules and the dark lateral streak coincide throughout their entire length. As a rule in the species of *Barbus* the lateral line is curved and runs below the dark streak anteriorly, though joining it on the hinder part of the body and caudal peduncle. According to illustrations, two other closely allied species have this peculiarity: *aurantiacus* Blgr., 1910 (figured 1916); and (very conspicuous) *rogersi* Blgr., 1911.

Both these species have very short or minute barbels; if they also possess the sensory ridges (which may easily be overlooked if the skin is shrivelled or contracted) the question will arise whether this species

is a synonym of *rogersi*, or perhaps both of them synonyms of *aurantiacus*.

In addition to the Okovango specimens, there are three, 33–55 mm. in length, from Insiza, S. Rhodesia. This locality is between Bulawayo and Gwelo, but whether the specimens are from the Zambesi system

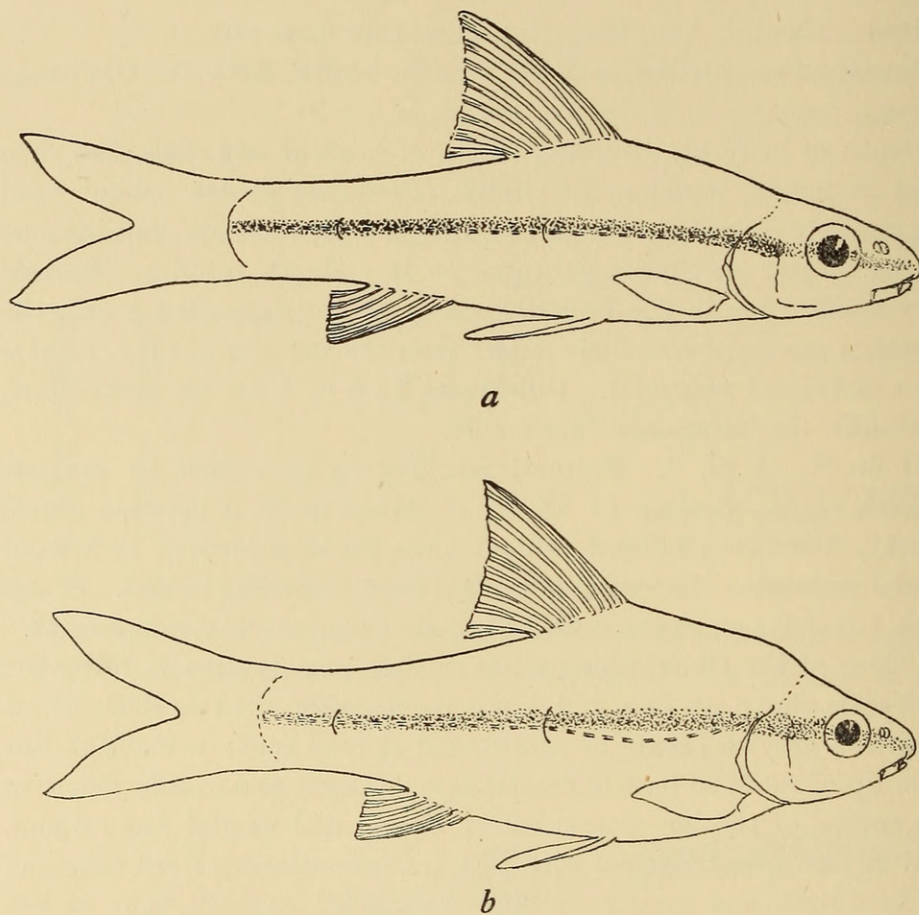


FIG. 6.—*Barbus* (*Beirabarus*). *a. okavangoensis* Brnrd. 63 mm.
b. palustris Herre. Paratype 59 mm. 10th and 20th scales in lat. line indicated.

or the Nuanetsi (Wanetsi) River, which flows into the Limpopo, is not recorded.

The specimens are not in very good condition, but from their body-depth, head-length, eye-diameter, profile, and straight lateral line appear to belong to the Okovango, rather than to the Beira, form.

	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	Barbels.
27 mm.	$3\frac{1}{4}$	$2\frac{2}{3}$	s < e	i < e	26	12	None.
30 "	$3\frac{1}{4}$	$2\frac{2}{3}$	"	"	26	12	None.
33 "	$3\frac{1}{4}$	$2\frac{3}{4}$	"	i = e	26	12	Anterior and posterior mere points.
40 "	$3\frac{1}{4}$	3	"	"	26-27	12	Minute.
50 "	$3\frac{1}{2}$	3	"	"	26-27	12	Minute.
55 "	$3\frac{2}{3}$	3	"	"	26-27	12	Minute.
65 "	$3\frac{2}{3}$	$3\frac{1}{4}$	s = e	" or i slightly > e	26-28	12	Not exceeding $\frac{1}{5}$ eye.

Barbus (Beirabarus) palustris Herre.

(Fig. 6, b.)

1936. Herre, Proc. Biol. Soc. Wash., xlix, p. 100 (Beira district, P.E.A.).

Thanks to the kindness of Dr. G. S. Myers of Stanford University, I have been able to examine 4 of Herre's paratypes (32-34 mm. and 59 mm.). I do not quite agree with Herre's statement, "maxillary barbel more than twice in eye, about equal to diameter of pupil"; the diameter of the pupil is a little *more than half* the eye-diameter in all four paratypes, as well as in the Okovango specimens.

The lateral line shows a slight but distinct *downward bend* from its beginning to about the 12th scale. The dark lateral stripe, however, is straight as in the Okovango specimens, consequently it runs across the *upper* part of the 1st or 2nd to the 11th or 12th tubuliferous scales.

The depth of body *exceeds* the length of head in specimens of 30 and 60 mm. length; the eye is relatively smaller than in the Okovango form; and the predorsal profile is elevated.

The remarkable feature of these two forms is the development of more or less parallel lines of minute mucus pores (Herre: sensory ridges) on the head. Without sectioning a piece of the skin it cannot be stated that they are definitely pores. In the interorbital and internarial area these structures appear as pale lines, more or less curved and intersecting, on the dark ground-colour. Neither on the top of the head nor on the cheeks or opercle are the lines constant or exactly alike in any two individuals.

In addition to these pores on the head, there are similar lines of

minute pores on the lateral line scales and some of the neighbouring scales, chiefly on the shoulders and anterior part of body. These

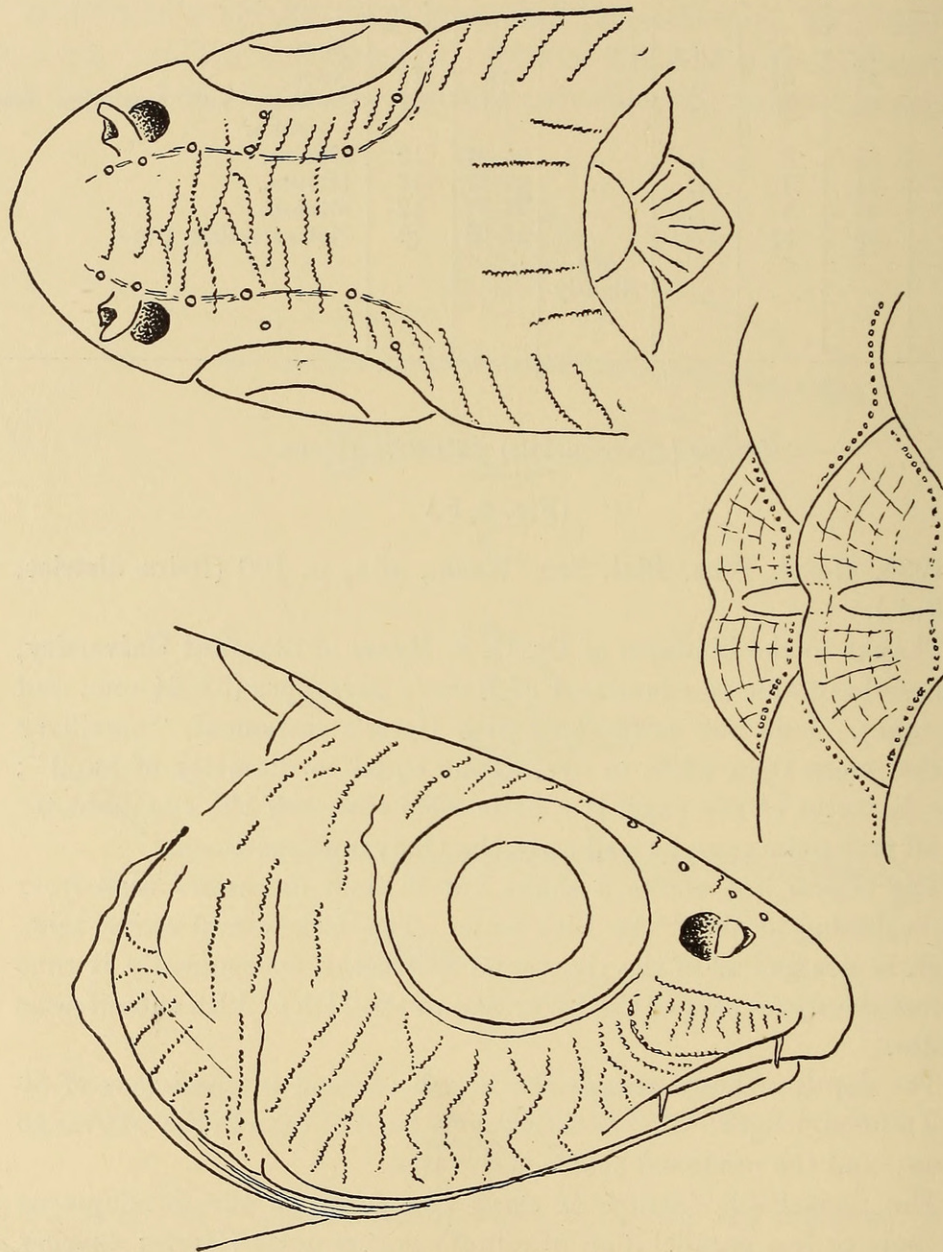


FIG. 7.—*Barbus (Beirabarus) okavangoensis* Brnrd., mucus pores on head and scales.

pores are in a single transverse and somewhat arcuate line on the exposed field of each scale, just behind the free margins of the scales in front. These scale pores are even less visible than the head pores when the specimen is submerged in liquid; to be properly seen the specimen must be removed from liquid and partially dried.

Some taxonomic distinction, either subgeneric or full generic, should be given to indicate this exceptional feature, which differentiates these two species from all other South African (? African) species. But I am not competent to judge the merits of Herre's proposed generic diagnosis.

FAMILY MOCHOKIDAE.

Gen. SYNODONTIS Cuv.

Excluding *colyeri* Blgr., 1923, from N. Rhodesia, and taking the triangular area between the points Lake Ngami, Lialui, and the Victoria Falls (with a linear extension to Tete on the Lower Zambesi) we find that seven species of this genus have been described and one other recorded:

<i>nebulosus</i> Peters, 1852	.	.	founded on one specimen.
<i>zambesensis</i> Peters, 1852	.	„	? several specimens.
<i>woosnami</i> Blgr., 1909	.	„	one specimen.
<i>macrostigma</i> Blgr., 1909	.	„	two specimens.
<i>leopardinus</i> Pelleg., 1914	.	„	one specimen.
<i>jallae</i> G. and T., 1917	.	„	one specimen.
<i>thamalakanensis</i> Fowl., 1935	.	„	two specimens.
<i>melanostictus</i> Blgr.	.	.	one specimen recorded by Boulenger, 1911, and nine by Fowler, 1935.

It may seem a little remarkable that so many species should be found within such a comparatively small area and within only one present-day river system. Moreover, it cannot be said that the validity of the species has been well confirmed by later collecting. According to published records there are three specimens of *zambesensis* (from the area in question) and eleven of *melanostictus*. The South African Museum has eighteen specimens, including Gilchrist and Thompson's material and material received since 1917, and also eleven specimens from the Okovango River. The latter are in a perfect state of preservation.

It is obvious that this small collection is quite inadequate for a revision of the Zambesi species, but such as it is, it seems to show that some of the characters hitherto relied upon as specific should be carefully tested.

The number of movable mandibular teeth varies with age: one specimen of *zambesensis* of 37 mm. has 11, two of 50 and 60 mm. have 16-18, one of 100 mm. has 20-22 teeth (see also *melanostictus*, *infra*). Young *zambesensis* have indications of a nodose front margin on the

maxillary barbel (method of preservation may have some effect in concealing or accentuating this feature), and the outer margin of the pectoral spine may be strongly serrate as in *melanostictus*. In fact it may be asked what is the morphological difference between *zambesensis* and *melanostictus*, especially in juveniles?

The shape of the humeral process seems to be a good character, and secondarily the length of the maxillary barbel (excluding of course minor individual variations such as "reaching to first $\frac{1}{4}$ or first $\frac{1}{3}$ of pectoral spine).

The following key may be useful as a preliminary aid to identification. *S. nigromaculatus* recorded from the Cubango River by Pellegrin (1936) is included.

- I. Humeral process narrow, longer than broad, acutely pointed, upper margin concave or straight. Mandibular teeth in adult up to 40.
 - A. Maxillary barbel long, reaching to middle of pectoral spine (the latter closed against body).
 1. Usually unspotted. Outer edge of pectoral spine usually smooth or feebly serrate, at least in adult *zambesensis*
 2. With very numerous small spots. Outer edge of pectoral spine usually strongly serrate.
 - a. Small spots *nigromaculatus*
 - b. Very small spots or dots *melanostictus*
 - B. Maxillary barbel short, reaching only to anterior $\frac{1}{4}$ of pectoral spine. Moderately small spots *colyeri*
- II. Humeral process broad, little if at all longer than broad, obtusely pointed, upper margin convex. Mandibular teeth in adult not exceeding 26.
 - A. Maxillary barbel short and usually smooth on anterior margin. Small spots *woosnami*, ?*leopardinus*
 - B. Maxillary barbel short and usually nodose on front margin.
 1. Large spots *macrostigma*
 2. Small spots, more or less elongate, and arranged more or less in longitudinal lines *jallae*

One suspects that *nebulosus* is merely an aberrant specimen of *zambesensis* (humeral process rather short and broad, intermediate between I and II in above key). If this were so, the name *zambesensis* must give place to *nebulosus* as having precedence.

According to the character of the maxillary barbel (described by Pellegrin as "simple") *leopardinus* may prove to be a synonym of *woosnami*; or, on the other hand, it may be a valid species, in which case *jallae* is probably a synonym of it. However that may be, *thamalakanensis* is a synonym of *jallae*.

The type of *colyeri* is an ovigerous ♀. As Boulenger said, it is closely allied to *zambesensis*.

Synodontis melanostictus Blgr.

1917. Gilchrist and Thomson, *l.c.*, pp. 560 and 579.

1935. Fowler, Ann. Transvaal Mus. xvi, p. 273.

1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 58.

1939. Ricardo, Fish. Lake Rukwa and Bangweulu, p. 61.

In the South African Museum: seven specimens from Lialui, Lake Ngami, Victoria Falls, and Sesheki. The three from Lialui all have very small spots or dots, 1–1.5 mm. in diameter, whereas in the others they are 2 mm. (in specimens 150–200 mm. in length); this difference does not seem very great *on paper*, but is immediately perceptible to the eye. In both cases the spots are *round*, and in *general* their diameter is less than the distance between any two of them.

There is a series of nine specimens from the Okovango River, 50–210 mm. in length. The two largest, 170 and 210 mm., have conspicuous white or whitish barbels, a feature not apparent in the preserved specimens from other localities; nor is it so conspicuous in the younger Okovango specimens.

The spots are approximately 2 mm. in diameter in all the specimens irrespective of length, except in two (65 and 70 mm.) in which they are 2.5–3 mm., giving a somewhat *macrostigma*-like appearance. In the smallest specimen the minute, nearly uniformly spread, speckling is beginning to become aggregated into spots; the specimen looks “patchy”.

In the three smallest specimens the front margin of the maxillary barbel is nodulose (all the specimens have been preserved in formalin, probably put alive into the liquid, and the skin is *plump*, not shrivelled) but in the larger ones it is merely villous.

The following table gives the increase in number of mandibular teeth, and the length of the maxillary barbel:—

50 mm.	. . .	26 teeth	. . .	10 mm.,	reaches to base of pectoral spine.
60	„ . .	26	„ . .	12	„ „ „
65	„ . .	26	„ . .	12	„ „ „
70	„ . .	28	„ . .	14	„ „ „
75	„ . .	28	„ . .	20	„ reaches $\frac{1}{3}$ along pectoral spine.
80	„ . .	28	„ . .	20	„ „ „
100	„ . .	26	„ . .	28	„ „ „
170	„ . .	33	„ . .	60	„ reaches $\frac{2}{3}$ along pectoral spine.
210	„ . .	36	„ . .	65	„ reaches just over half-way.

On two of the smaller specimens from the Okovango River (80 and 100 mm.) parasitic Copepods (*Chonopeltis* sp. Fam. *Argulidae*) were found, mainly at the bases of the barbels on the chin, and the folds of the lower lip, but also in the axils of the pectoral fins.

Pellegrin's record is from Humbe on the Kunene River.

Synodontis jallae G. and T.

1917. Gilchrist and Thompson, *l.c.*, p. 561.

1931. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxiii, p. 236 (*woosnami* non Blgr.).

1935. *Id.*, Ann. Transvaal Mus., xvi, p. 274, fig. 12 (*thamalakanensis*)

In the South African Museum, besides the type, there is an additional specimen from Sesheki, and one from Lialui. The latter was collected by the Rev. Ellenberger in the same locality as the specimen he sent to Pellegrin, on which *leopardinus* was founded. Like localities do not necessarily imply synonymy, but they are suggestive. In fact it is only the size of the spots, which are larger in *leopardinus* (judging by Pellegrin's description "atteignant à peine les dimensions de l'œil"), which makes one hesitate to put *jallae* into synonymy (cf. *melanostictus* for variation in size of spots, *supra*; and Pellegrin, 1936, *l.c.*, *supra*).

The type of *jallae* has round spots 1-1.5 mm. in diameter (eye 9 mm.) numerous and evenly distributed. A second specimen (topo-type) has larger spots, 2 mm., most of them distinctly elongate oval or even linear, and showing a linear arrangement on the hinder part of body. The Lialui specimen has small spots like the type, but those on anterior part of body are mostly round, while those on the hinder part are more or less elongate. Lastly, there are two specimens from the Okovango River which have spots of the larger size (the intervening ground colour forming a pale network), more or less oval in shape and arranged in lines. The paratype of *thamalakanensis* figured by Fowler seems to represent the extreme development of this linear arrangement of elongate oval spots. Cf. also Pellegrin, 1936, *l.c.*, for linear arrangement of spots in *nigromaculatus* Blgr. from the Cubango River.

An immaculate lower surface (cf. Fowler, 1935, p. 275) is merely an individual character; one of the Okovango specimens is spotted from chin to vent, the other immaculate (except for microscopic pigment specks) as far as base of ventrals.

The following table gives the number of mandibular teeth, and the

length of the maximillary barbel; in the case of the latter some allowance must be made for shrivel in the Sesheki and Lialui specimens:—

Okovango	110 mm.	.	40 teeth	.	30 mm., reaches $\frac{2}{3}$ along
					pectoral spine.
Lialui	130 „	.	18 „	.	30 „ reaches $\frac{1}{2}$ along
					pectoral spine.
ovig. ♀—Sesheki	150 „	.	23 „	.	35 „ reaches $\frac{1}{2}$ along
					pectoral spine.
Okovango	165 „	.	14 „	.	35 „ reaches $\frac{1}{10}$ along
					pectoral spine.
Type <i>jallae</i> —Sesheki	190 „	.	16 „	.	32 „ scarcely reaches spine
					(falls short by $\frac{1}{8}$
					length of spine).
<i>leopardinus</i>	160 „	.	21 „	.	does not reach
					pectoral spine.
<i>thamalakanensis</i>	184–194 mm.	.	17–18 teeth	.	reaches $\frac{1}{10}$ – $\frac{1}{8}$ along
					spine.

The low number of teeth on one of the Okovango specimens and the remarkably high number in the other (and smaller) are points worth noting.

The front edge of the maxillary barbel is nodulose in the Sesheki, Lialui, and Okovango specimens, especially so in the Lialui one; it is also nodulose in Fowler's figures, of *thamalakanensis*; in *leopardinus* the barbel is described as "simple", presumably the front edge is smooth (or not conspicuously nodulose).

A certain amount of variability in the posterior processes of the occipito-nuchal shield is noticeable in the series of *melanostictus* from the Okovango, but it is much more noticeable in these specimens of *jallae*. Maybe it is a sexual difference, but that is not possible to determine with so few specimens at hand.

Pellegrin described the process in *leopardinus* as "pointu"; in *jallae* (type) it is narrowly rounded as in the figure of *thamalakanensis*; in the larger Okovango specimen rounded but obliquely bevelled off below; in the smaller Okovango specimen it would probably be described as pointed; in the smaller Sesheki specimen (ovig. ♀) and the Lialui specimen it is broadly rounded.

The humeral process does not seem to vary.

FAMILY BAGRIDAE.

Auchenoglanis ngamensis Blgr.

1913. Gilchrist and Thompson, *l.c.*, p. 454, fig. 105.

1917. *Id.*, *ibid.*, pp. 578, 579.

1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 58.

Recorded from Sesheki on the Zambesi River, in the appendix to Gilchrist and Thompson's work, and from the Cubango River, and the Chiumbe River, N.E. Angola (a tributary of the Kasai, Congo system) by Pellegrin.

There are two specimens: 64 and 180 mm. in length, from the Okovango River.

Length of head 3 in body (excl. caudal); eye $3\frac{1}{2}$ and $4\frac{1}{2}$ in snout, 7 and 9 in head, $2\frac{1}{3}$ and $2\frac{1}{2}$ in interorbital width (in the smaller and larger specimens respectively). Gill-rakers 4+9 on anterior arch, decreasing in length below, the lowermost (anterior) 2 or 3 being short and knob-like.

Boulenger's figure shows the 3rd ray of ventral fin abruptly longer than, and projecting beyond, the others. In these two specimens the 2nd ray is the longest, but not abruptly so, merely giving the fin an ovate shape, especially in the larger specimen.

The larger specimen with few spots, mostly forming vertical bars; smaller specimen with numerous spots, with narrow intervening pale reticulation.

FAMILY CICHLIDAE.

1920. Regan, Ann. Mag. Nat. Hist. (9), v, p. 33 (Tanganyika genera).

1920. *Id.*, *ibid.* (9), v, p. 422 (Madagascan genera).

1921. *Id.*, *ibid.* (9), viii, p. 632 (Lakes Edward and Kivu).

1921. *Id.*, Proc. Zool. Soc. London, p. 675 (Lake Nyassa).

1922. *Id.*, *ibid.*, p. 157 (Lake Victoria).

1922. *Id.*, Ann. Mag. Nat. Hist. (9), x, p. 249 (African and Syrian genera).

These papers have done much to clarify the classification of this difficult family. In the last-mentioned paper Regan has suggested a reduction in the number of South African species in the genus *Tilapia*. It is probable that several more so-called "species," based on single specimens or very limited material, will also fall into synonymy when a proper investigation of the rivers is undertaken.

The number of species recorded from the Zambesi area is considerable; some of them certainly merely "museum species."

In addition to Regan's suggestions with some but not all of which I agree (he did not see the actual types of Gilchrist and Thompson's species), I would suggest the following synonymy:—

Tilapia sheshekensis G. and T., 1917 = *macrochir* juv.

Tilapia alleni Fowler, 1931 = *macrochir*.

Tilapia deschauenseei Fowler, 1931 = *sparrmanii*, as already suggested by Trewavas (1936).

Tilapia ellenbergeri G. and T., 1917, apparently accepted by Regan as a valid species, proves on examination of the type to be *Haplochromis moffatii* (Cast.).

Pelmatochromis genisquamulatus Pelleg., 1914 = *Serranochromis thumbergi* (Cast.) as already suggested by Gilchrist and Thompson.

Paratilapia carlottae Blgr. is considered by Regan to be a synonym of *giardi* Pellegr., a species with 6 scales between pectoral and ventral fins; the type of *carlottae*, however, has only 3 or 4 scales like *gibbiceps* Blgr., 1911. The latter should therefore become a synonym of *carlottae*, 1905.

Chromys moffatii Cast. is not a synonym of *T. sparrmanii*, as suggested by Trewavas (1936), but a valid species as maintained by Regan.

Astatotilapia ellenbergeri Pelleg., 1920, agrees with *giardi* in having 12 gill-rakers, and with *darlingi* in having 4 cheek scales; but the description does not allow it to be run down in Regan's key.

Paratilapia arnoldi G. and T., 1917 = *Haplochromis darlingi*. Regan's synonymy confirmed by examination of the type.

Tilapia rumsayi G. and T., 1917, regarded by Regan as synonymous with *Haplochromis acuticeps*, but does not agree with his 1922 description as the middle teeth of the lower pharyngeal are stout and blunt, as in *darlingi*. Six anal rays is probably an individual feature.

The following synopses only contain the species recorded from the Zambesi and Okovango systems.

KEY TO GENERA.

1. Teeth usually not conical. Scales cycloid. Caudal truncate (at least in Zambesi species) *Tilapia*
2. Teeth usually conical. Scales usually denticulate, but often very finely or obscurely so.

- a. 3rd vertebra with inferior apophyses.
- i. Teeth nearly uniform in size. Caudal usually rounded
Haplochromis
 - ii. Middle pairs of teeth more or less enlarged, in both jaws. Caudal subtruncate *Hemichromis*
- b. 4th vertebra with inferior apophyses.
- i. Pharyngeal teeth stout, blunt. Caudal subtruncate *Sargochromis*
 - ii. Pharyngeal teeth slender. Caudal rounded or rounded subtruncate *Serranochromis*

Gen. TILAPIA A. Smith.

1920. Regan, *l.c.*, p. 37.1922. *Id.*, Ann. Mag. Nat. Hist. (9), x, p. 250.1922. *Id.*, Proc. Zool. Soc. London, p. 676.

Teeth usually not conical, but bi- or tri-cuspid. Lower pharyngeal subtriangular. Cheek scales in 2-4 (rarely 5) series. Caudal truncate (in the under-mentioned species). Gill-rakers slender, pointed.

A. Anal spines III. Lower pharyngeal with short anterior blade (*Tilapia*).

1. Gill-rakers 8-12 on lower part of 1st arch. Pectoral not reaching beyond vent.
 - a. D xiii-xv. 9-11. A (rays) 8-10. Cheek scales 2-3
sparmanii (syn. *deschauenseei*)
 - b. D xiv-xvi. 10-12. A 9-10. Cheek scales 3-4 (5)

{	<i>melanopleura</i> (syn. <i>swierstrae</i> <i>mackeani</i> <i>sykesii</i> <i>druryi</i> <i>kirkhami</i>)
---	---
2. Gill-rakers 15-20. Pectoral reaching to origin of anal (sometimes slightly beyond).
 - a. D xv-xvii. 10-12. A 9-10. Cheek scales 2-4

{	<i>mossambica</i> (syn. <i>vorax</i> <i>natalensis</i> <i>T. arnoldi</i>)
---	---
 - b. D xvi. 10-11. A 8-9. Cheek scales 2. Caudal covered with small scales . . . *squamipinnis* (Shiré R.)
3. Gill-rakers 20-25. Pectoral reaching at least to origin of anal, usually beyond.
 - a. D xvi-xvii. 13. A 11-12. Cheek scales 3-4. Depth more than twice in length *kafuensis*
 - b. D xv-xvi. 11-12. A 10. Cheek scales 2-3. Depth about twice in length

{	<i>macrochir</i> (syn. <i>alleni</i> <i>sheshekensis</i>)
---	--
 - c. D xvi-xvii. 11-13. A 9-11. Cheek scales 2-3. Depth more than twice in length

{	<i>andersonii</i> (syn. <i>intermedia</i>)
---	--

B. Anal spines IV. Lower pharyngeal with long anterior blade
(*Sarotherodon*).

D xvi-xvii. 10-13. A 9-10. Cheek scales 2-3. Gill-rakers

15-19. Depth 2-2½ in length *shirana* (Shiré R.)

Tilapia sparrmanii A. Smith.

Fig. 8, *a*.

1835. A. Smith, MSS. Diary of Exped., 23rd Jan., "Fish No. 76".
Description of colour. Locality: Bootscap, Hartz River, Becuana-
land.

1840. *Id.*, Ill. Zool. S. Afr. Pisces, pl. 5 (coloured): "North of
Orange River".

1917. Gilchrist and Thompson, *l.c.*, p. 502 (*sparrmani* [sic]), and
p. 509 (Kuruman specimen as *calliptera*, non Gnthr.)

1935. Fowler, Ann. Transvaal Mus., xvi, 285 (*sparrmani*) Ngami
and Chobe area.

1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 60 (*sparrmani*),
Cubango River.

1936. Trewavas, Novit. Zool., xl, p. 72, footnote 1, and p. 73,
footnotes 1, 2.

1939. A. Smith's Diary, ed. P. R. Kirby, van Riebeeck Soc. Publ.,
Cape Town, no. 20, vol. 1, p. 227. Locality "Bootscap" = Boetsap.,
p. 228, "Fish No. 76".

1939. Ricardo, Fish. Lake Rukwa and Bangweulu, p. 63 (*sparrmani*).

1942. Bertram, Borley and Trewavas, Fish. Lake Nyasa, pp. 23,
40 (*sparrmani*).

1943. Barnard, Ann. S. Afr. Mus., xxxvi, pp. 111, footnote,
117.

Boulenger seems to have added the word "Namaqualand" to Andrew
Smith's locality "north of Orange River"; and Trewavas (1936)
quotes Boulenger. From Andrew Smith's Diary we now know the
exact type locality for this species; north of the Orange River, it is
true, but a long way from Namaqualand.

Gilchrist and Thomspson's Kuruman specimen is not *calliptera* but
sparrmanii.

On a recent (1939) South African Museum expedition to Kuruman
specimens of both *T. sparrmanii* and *H. moffatii* were collected. Thus
Trewavas's suggestion that *Chromys moffatii* Cast. is "probably a
Tilapia" is disproved. Nor can I accept Trewavas's statement that
C. ovalis Stndr. is a synonym of *sparrmanii*, as Steindachner's original

material had a rounded tail. Regan (1922) regarded *ovalis* as a synonym of *moffatii*.

T. sparrmanii has been recorded from the Zambesi system and Ngamiland (and other localities). The South African Museum has material from Bulawayo, Kafue River, Sesheki and Lialui, Lake Ngami, and the Okovango River. But I confess I am unable to

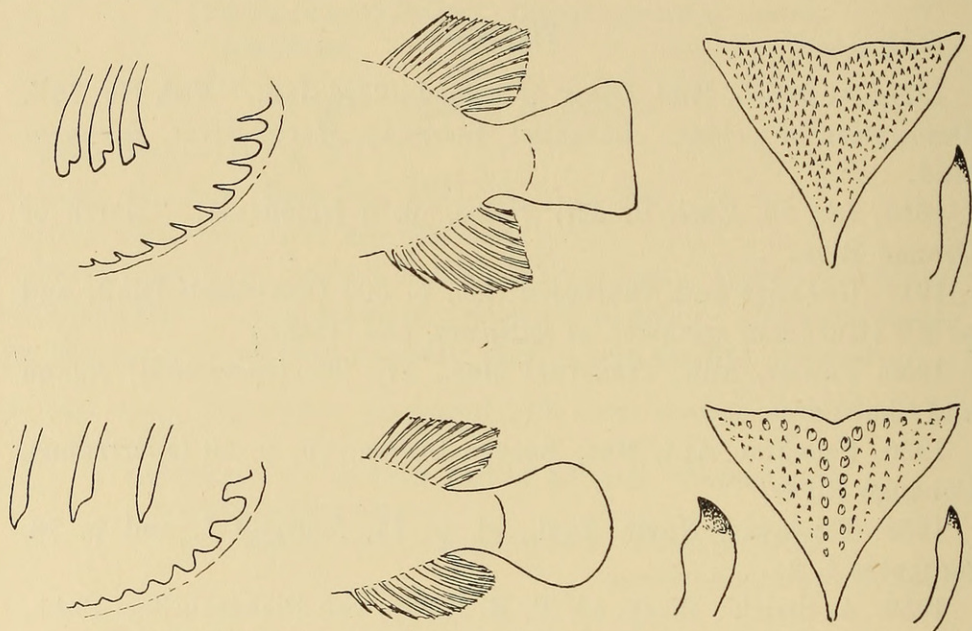


FIG. 8.—Cichlids from Kuruman. Above *Tilapia sparrmanii* A. Smith; below *Haplochromis moffatii* (Cast.). Three teeth from upper jaw, consecutive, spacing natural; lower part of 1st gill arch; hind part of body showing shape of soft dorsal, caudal, and anal; lower pharyngeals, with individual teeth further enlarged.

find in the material at hand any constant characters by which a preserved specimen may be identified as *sparrmanii* or young *melanopleura*.

Trewavas (1936, p. 72, footnote 1) considers *deschauenseei* Fowler, 1931, as probably synonymous with *sparrmanii*.

Tilapia melanopleura Dum.

- 1917. Gilchrist and Thompson, *l.c.*, p. 495, fig. 127.
- 1917. *Id.*, *ibid.*, p. 498, fig. 128 (*swierstrae*), p. 499 (*mackeani*), p. 500 (*sykesii*), p. 500 (*druryi*), p. 510 (*kirkhami*).
- 1922. Regan, *Ann. Mag. Nat. Hist.* (9), x, p. 251, synonymy.
- 1935. Fowler, *Ann. Transvaal, Mus.*, xvi, p. 281, fig. 16.
- 1936. Pellegrin, *Arq. Mus. Bocage Lisbon*, vii, p. 60.
- 1939. Ricardo, *Fish. Lakes Rukwa and Bangweulu*, p. 63.

1942. Bertram, Borley and Trewavas, Fish. Lake Nyasa, pp. 23, 39, fig. 3, *a* (gillrakers).

I have examined the type specimens of Gilchrist and Thompson's species, which Regan suggested were synonyms of *melanopleura*, and I see no reason for disagreeing with Regan. All these "species" were founded on single specimens and are nothing more nor less than "museum species".

Tilapia macrochir Blgr.

1915. Boulenger, *l.c.*, iii, p. 160, fig. 105.

1917. Gilchrist and Thompson, *l.c.*, p. 488, fig. 123, and p. 579.

1917. *Id.*, *ibid.*, p. 489 (*sheshekensis* = juv.), p. 495 (three specimens from Kafue River as *squamipinnis*, non Gnthr.).

1917. *Id.*, *ibid.*, p. 492 (Victoria Falls specimen as *galilaea*, non Art.).

1931. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxiii, p. 238, fig. 1 (*alleni*).

1935. *Id.*, Ann. Transvaal Mus., xvi, p. 280 (also *sheshekensis* and *alleni* as separate species).

? 1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 60 (*galilaea* ? non Art.).

1939. Ricardo, Fish. Lakes Rukwa and Bangweulu, p. 63.

The Victoria Falls specimen (95 mm. standard, 120 mm. total length), identified by Gilchrist and Thompson as *galilaea*, belongs here, as also the three Kafue River specimens doubtfully assigned to *squamipinnis*.

There are eight specimens, 150–320 mm., in the South African Museum from Lake Ngami, Victoria Falls, Sesheki, Lialui, Mazuli River, Rhodesia; also eight specimens, 180–280 mm., from the Okovango River.

All the Okovango specimens, on arrival at the Museum after a short period in formalin, have a pale border, varying in width, on the longest rays of the dorsal and anal fins, and on the hind margin of the caudal fin (somewhat similar to the figure of *Paratilapia longimanus*, see Gilchrist and Thompson, *l.c.*, fig. 140). No definite bars across the chin (as in *alleni*), but the throat often appears somewhat clouded or blotchy.

Regan thought *sheshekensis* might be a synonym of *andersonii*, but the type and several other specimens from the type locality appear to be merely the juveniles of *macrochir*.

Gen. HAPLOCHROMIS Hilg.

1921. Regan, Proc. Zool. Soc. London, pp. 676, 685.

1922. *Id.*, Ann. Mag. Nat. Hist. (9), x, pp. 250, 253 (key to species).

Teeth conical or compressed, with or without cusps (but not incisor-like), in 2 or more series. Third vertebra with inferior apophyses. Cheek-scales in 3-7 series. Caudal fin usually rounded.

South African (Zambesi and southwards) species belong to subgen. *Ctenochromis* Pfeffer, with outer series of bicuspid or conical teeth, and one or more inner series of tricuspid or conical teeth (Regan).

Gill-rakers usually stout, blunt, sometimes T-shaped.

In 1921 Regan accepts *Astatotilapia* Pelleg. as well as *Haplochromis*. In the former the teeth in outer series of upper jaw increase in size posteriorly, in the latter they decrease. In *Astatotilapia* were included (*inter alia*) *swynnertoni*, *calliptera*, and *moffatii*. In 1922, however, he withdrew *Astatotilapia* after examining Lake Victoria species (Proc. Zool. Soc., p. 158, footnote).

In the Kuruman specimens, which it is reasonable to regard as *moffatii* (see *infra*), the outer upper teeth may project a little more from the gum, but cannot be said to increase in size posteriorly.

Boulenger (*l.c.*, iii, p. 302) admits that he was unable to separate some specimens of *strigigena* from young *moffatii*. Pellegrin (1920, Bull. Soc. zool. Fr., xlv, p. 150) describes *Astatotilapia ellenbergeri* as near to *strigigena* and *moffatii* (but with more gill-rakers). This serves to show the great difficulty of defining some of the species, and the small progress, if any, which can be expected from discussions on affinities and synonymy. What is really wanted is the investigation *in the field* of the full life-histories and range of variation of the species in any particular locality.

- I. Dorsal rays 12-15. Pharyngeal teeth obtusely conical. Gill-rakers 9-12. Caudal rounded.

A. Depth of preorbital not greater than eye.

1. Chest scales small, 6 between pectoral and ventral fins. Pectoral a little shorter than head . . . *giardi*
2. Chest scales large, 3-4 between pectoral and ventral. { *carlottae* *
Pectoral as long as head { ? *gibbiceps*

- B. Preorbital a little greater than eye { *smithii*
(syn. *T. woosnami*
P. robustus)

- C. Preorbital much greater than eye *frederici*

* See above, p. 447.

II. Dorsal rays 8-12.

A. Cheek-scales 6-7.

1. Caudal truncate. Gill-rakers 9 *jallae*
2. Caudal rounded *humilis*

B. Cheek-scales 3-5. Gill-rakers 7-10.

1. Maxillary to between nostril and eye. Caudal peduncle longer than deep. Lower pharyngeal teeth small, hooked. Chest scales small *acuticeps* (syn. ? *T. rumsayi*) *
2. Maxillary to front margin of eye.

a. Lat. series of scales 29-32. Middle teeth of lower pharyngeal stout, blunt. Chest scales small. D xiv-xvi. 8-12. A 7-9.

- i. Caudal subtruncate $\left\{ \begin{array}{l} \textit{darlingi} \\ \text{(syn. } P. \textit{arnoldi)} \\ \text{? } A. \textit{ellenbergeri} \text{ } \dagger \\ \text{? } T. \textit{rumsayi} \end{array} \right.$
- ii. Caudal rounded *calliptera*

b. Lat. series of scales 26-30. Lower pharyngeal teeth all small, conical.

- i. Chest scales small, 5-6 between pectoral and ventral. Caudal subtruncate *swynnertoni*
- ii. Chest scales large, 3-4 between pectoral and ventral. Caudal rounded $\left\{ \begin{array}{l} \textit{moffatii} \\ \text{(syn. } T. \textit{ellenbergeri} \text{ G. and T.} \\ \textit{philander)} \end{array} \right.$

Haplochromis moffatii (Cast.).

Fig. 8 b.

1861. Castelnau, Mem. Poiss. Afr. Austr., p. 16 (*moffatii*, original spelling) Kuruman River.

1922. Regan, Ann. Mag. Nat. Hist. (9), x, p. 257 (*moffati*).

As mentioned above only two Cichlids were collected by the South African Museum Expedition (1939) at Kuruman, the type locality for Castelnau's species. The largest *moffatii* is 87 mm. in length; Regan gives 120 mm. as maximum length, Castelnau's was 140 mm. We can ignore as an *obiter dictum* Castelnau's statement that the Cape Museum possessed one double that length.

Although Castelnau's description is quite inadequate for modern requirements, it contains the one character necessary to identify a Cichlid fish from Kuruman, granting that actually only two species

* See above, p. 447.

† Not to be confused with *Tilapia ellenbergeri* G. and T., 1917. Pellegrin's species has 12 gill-rakers, as also has *giardi* Pelleg.

are present in that river, viz. the *rounded* caudal. The fin formulas given by Castelnau fit both *T. sparrmanii* and *H. moffatti*, but the former has a square tail.

These two are the only Cichlids recorded, not only from the Kuruman River, but from the whole of the Orange River system (Gilchrist and Thompson's Potchefstroom specimens identified as *H. desfontainesii* are really *moffatti*).

Twelve specimens, 30–58 mm., from the Okovango River. A dark lateral stripe broken up into darker spots where the faint vertical cross-bars meet it; a black opercular spot, and a dark bar from eye to mouth; soft dorsal and anal yellowish with pale (transparent) spots, and pink edge, spinous dorsal with faint red margin; caudal pale yellowish with wavy or zigzag cross-bands.

Gen. HEMICHROMIS Peters.

1922. Regan, Ann. Mag. Nat. Hist. (9), x, pp. 250, 253.

Teeth conical, middle pairs more or less enlarged (see fig. 156, Gilchrist and Thompson). Cheek-scales in 5 series. Gill-rakers 9, blunt, more or less T-shaped. Caudal subtruncate.

Hemichromis fasciatus Peters.

1917. Gilchrist and Thompson, *l.c.*, p. 540, fig. 156.

Specimens in the South African Museum from Victoria Falls, Sesheki, and Lake Ngami.

Gen. SARGOCHROMIS Regan.

1920. Regan, Ann. Mag. Nat. Hist. (9), v, p. 45, footnote.

1922. *Id.*, *ibid.*, (9), x, pp. 250, 263.

Teeth conical in adult, sometimes cuspidate in young. Pharyngeal teeth massive, the teeth stout, blunt. 4th vertebra with a pair of apophyses united below. Cheek scales in 4–7 series. Gill-rakers 10–12, blunt, more or less T-shaped. Caudal subtruncate.

- | | |
|---|---|
| 1. Cheek-scales in 4–5 series | } <i>codringtoni</i>
(syn. <i>P. marginata</i>) |
| 2. Cheek-scales in 6–7 series | |
| | <i>angolensis</i> |

Sargochromis codringtoni (Blgr.).

1917. Gilchrist and Thompson, *l.c.*, p. 527, fig. 146 (*Paratilapia c.*).

1917. *Id.*, *ibid.*, p. 531 (*Paratilapia marginata*).

1917. *Id.*, *ibid.*, p. 535 (Kafue specimens as *P. mellandi*, non Blgr.).

1922. Regan, Ann. Mag. Nat. Hist. (9), x, p. 263.

Regan makes *codringtoni* the genotype, and in the key gives the difference between *codringtoni* and *mellandi* as respectively: depth twice, and depth $2\frac{1}{3}$ – $2\frac{2}{3}$, in length. *S. mellandi* was described from Lake Bangweolo specimens, 150–200 mm., but Boulenger (*l.c.*, p. 359, footnote) identified a specimen (length not stated) from the Kafue River as this species.

S. codringtoni was described from Zambesi specimens 300 mm. in length.

In the South African Museum there are: types of *marginata* G. and T., 120 and 295 mm. (95 and 232 mm. standard length) from Lialui and Victoria Falls, three others from Lialui, three from Sesheki, and three of the Kafue specimens recorded as *mellandi* by Gilchrist and Thompson. Also nine specimens, 75–245 mm., from the Okovango River.

The latter series is not a long one, even when supplemented by the specimens from the other localities, but it appears to average out to the result that the younger stages are less deep in the body, *i.e.* more *mellandi*-like, than the adults. There is, however, one possible objection. Some or all of the younger specimens may be *Haplochromis*, and apparently there is no means of distinguishing the *Haplochromis* species with blunt pharyngeals except by dissection or radiograph of every specimen to see on which vertebra the apophyses are situated.

	L/D.	L/H.	H/E.	S/E.	Snout in relation to postorbital part of Head.
Okovango { 75 mm.	$2\frac{4}{5}$	$2\frac{4}{5}$	3	1	Subequal.
115 "	$2\frac{3}{4}$	$2\frac{3}{4}$	4	$1\frac{1}{2}$	"
140 "	$2\frac{1}{2}$	$2\frac{3}{4}$	4	$1\frac{1}{2}$	"
Sesheki, 190 "	$2\frac{1}{3}$	$2\frac{3}{4}$	$4\frac{1}{2}$	$1\frac{2}{3}$	"
Okovango, 245 "	$2\frac{1}{4}$	$2\frac{3}{4}$	$4\frac{3}{4}$	$1\frac{3}{4}$	Snout slightly < p.
Lialui, 300 "	2	3	$4\frac{4}{5}$	2	s < p.
Sesheke, 235 "	a little less than 2	3	5	2	s < p.

All the Okovango specimens have the soft dorsal, anal, caudal,

and ventrals with a broad pale border (cf. G. and T.'s description of *marginata*).

Possibly Fowler's *Paratilapia deschauenseei* (1931) and specimens identified as *P. mellandi* (1935, Ann. Transv. Mus., xvi, p. 292) belong here.

Gen. *SERRANOCHROMIS* Regan.

1920. Regan, Ann. Mag. Nat. Hist. (9), v, p. 45, footnote.

1922. *Id.*, *ibid.* (9), x, pp. 250, 263.

Teeth conical. Pharyngeal teeth slender. 4th vertebra with a pair of small inferior apophyses. Cheek scales in 5-10 series. Gill-rakers 10-12, blunt, more or less T-shaped.

1. Cheek scales in 5-6 series. Premaxilla extending to between orbits $\left\{ \begin{array}{l} \textit{macrocephalus} \\ \text{(syn. } \textit{longimanus}) \end{array} \right.$
2. Cheek scales in 7-10 series.
 - a. Premaxilla not extending beyond front margin of orbits. Head $2-2\frac{1}{4}$ as long as broad. $\left\{ \begin{array}{l} \textit{thumbergi} \\ \text{(syn. } \textit{P. ellenbergeri}) \\ \textit{P. zambesensis} \\ \textit{P. ngamensis} \\ \textit{genisquamulatus} \end{array} \right.$
 - b. Premaxilla extending to between orbits. Head $2\frac{1}{2}-3$ as long as broad *angusticeps*

In Miss Ricardo's Report on Fish. . . . Lakes Rukwa and Bangweulu (1939, p. 64) Boulenger's *Paratilapia kafuensis* (1908) is recorded without any reason being given for resuscitating as a distinct species a form which Boulenger later (1915) regarded as the female sex of *angusticeps*.

Serranochromis thumbergi (Cast.).

1861. Castelnau, Mem. Poiss. Afr. Austr., p. 13 (*Chromys thumbergi* original spelling).

1914. Pellegrin, Bull. Soc. zool. Fr., xxxix, p. 27 (*Pelmatochromis genisquamulatus*).

1917. Gilchrist and Thompson, *l.c.*, p. 526, fig. 145 (*Paratilapia t.*).

1917. *Id.*, *ibid.*, p. 521, fig. 141 (*Paratilapia ellenbergeri*).

1917. *Id.*, *ibid.*, p. 522, fig. 142 (*Paratilapia zambesensis*).

1917. *Id.*, *ibid.*, p. 539, fig. 155 (*Pelmatochromis ngamensis*).

1922. Regan, Ann. Mag. Nat. Hist. (9), x, p. 264.

1939. Ricardo, Fish. Lakes Rukwa and Bangweulu, p. 64 (*thumbergii*).

1942. Bertram, Borley, and Trewavas, Fish. Lake Nyasa, p. 55 (err. inserted among *Cyprinidae*), fig. 7, c.

The types of the three species described by Gilchrist and Thompson and placed in synonymy by Regan, have been examined and Regan's suggestions confirmed.

A good series has been received from the Okovango River, the smallest measuring 55 mm. in length. It is the smallest specimen in the Museum collections and its proportions are given here for comparison with a rather remarkable specimen described below.

Depth $3\frac{1}{2}$ in length, very slightly greater than distance from tip of snout to preopercle. Head $2\frac{2}{3}$ in length. Eye very slightly greater than snout, 3 in length of head, nearly twice the interorbital width. Width of head (at preopercle) $2\frac{1}{4}$ in length of head.

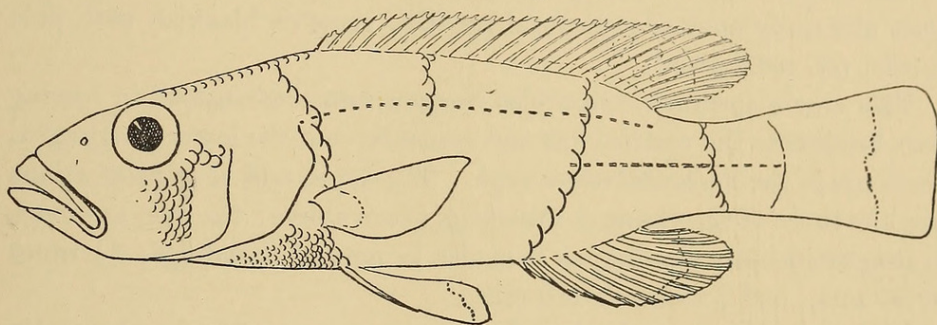


FIG. 9.—*Serranochromis* sp. 99 mm. Okovango River. Possibly an abnormally slender young *thumbergi*.

Coloration of juveniles (about 90 mm.) from the Okovango River: pale brownish with scattered orange spots on hinder part of body and caudal peduncle; a dark lateral stripe, with indications of another between it and the dorsal fin, more or less well-marked vertical cross-bars; a black opercular spot, lateral stripe continued across gill-cover to eye, a dark bar from eye to mouth; dorsal pale buff or greenish, edged with scarlet, the soft portion with dark spots more or less forming wavy longitudinal bands, anal yellow with a few deep red spots, and a reddish-orange border, caudal yellowish shading into red on lower lobe, with reddish-brown spots, ventrals pale, but somewhat suffused near the spine.

Serranochromis sp. ? *thumbergi* aberr.

Fig. 9.

Depth of body equal to distance from tip of snout to preopercle, $3\frac{1}{2}$ in length. Head $2\frac{2}{3}$ in length of body. Eye 4 in head, $1\frac{1}{3}$ in snout. Interorbital $1\frac{1}{3}$ in eye, nearly 2 in snout. Maxilla exposed. Pre-maxilla extending to vertical from front border of eye. Teeth conical,

3 rows in upper jaw, very few teeth in the two inner rows, a single row in lower jaw. Gill-rakers 9-10, pointed. Lower pharyngeal teeth few and conical, not enlarged or blunt. D xv. 13-14. A iii. 10. Pectoral short, equal to distance between tip of snout and hind margin of eye. Caudal subtruncate. Scales denticulate; lat. series 34; lat. lines 25 and 16; cheek with 7-8 series, chest scales small.

99 mm. Blackish, with black lateral stripe expanded into half a dozen diamond-shaped marks where the faint cross-bars meet it (cf. G. and T.'s fig. 141, of *P. ellenbergeri* = juv. *thumbergi*); dorsal and anal blackish, soft dorsal with a few pale spots basally, apical portion of soft dorsal and of anal pale; posterior half of caudal pale, basal part obscurely spotted; pectoral greyish, ventrals blackish with pale border (cf. *codringtoni*).

This single specimen resembles *Sargochromis codringtoni* in having pale borders to the vertical fins and ventrals; but the lower pharyngeal teeth are of the *Serranochromis* type. The depth and head proportions are like those of the young *S. thumbergi* given above; the eye, however, is proportionately smaller, as it is also in normal *thumbergi*; $4\frac{1}{2}$ times at 90 mm., and 5 times at 110 mm.

The suggestion is made that this specimen is possibly an abnormally slender *thumbergi*, i.e. abnormally so for a specimen of its length. Its elongate shape somewhat resembles a *Lamprologus* or *Champsochromis*.

Whether that be so or not, it would obviously be bad zoology to regard it as an undescribed species, especially as there is already a surfeit of synonyms among the Cichlids. A figure is given in case more specimens are collected in the future.



Barnard, K. H. 1948. "Report on a collection of fishes from the Okovango river, with notes on Zambesi fishes." *Annals of the South African Museum. Annale van die Suid-Afrikaanse Museum* 36, 407–458.

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