

abdomen, seen from above, not showing black hair projecting at the sides; last dorsal segment in lateral profile not in the least concave; hair on inner side of hind tarsi longer, coarser, and redder, being very bright ferruginous. Clypeal margin straight and simple, but there is a strong submarginal channel; abdomen shovel-shaped, with very conspicuous white hair-bands; ventral scopa cream-colour, black on the last segment; maxillary palpi stout, third joint longest; second joint of labial palpi conspicuously longer than first.

Hab. Boulder, Colorado, at flowers of *Opuntia*, collecting pollen, July 3, 1905 (*W. P. Cockerell*).

University of Colorado,
Boulder, Colorado, U.S.A.,
Jan. 2, 1906.

XXIX.—*A Revision of the Fishes of the South-American Cichlid Genera Cichla, Chætobranchus, and Chætobranchopsis, with Notes on the Genera of American Cichlidæ.*
By C. TATE REGAN, B.A.

THE present paper is the last of a series describing the American Cichlidæ in the British Museum*, and has been written in order to complete my account of the group. It has seemed useful to give a synopsis of all the genera and to offer some remarks on their relationships and distribution.

I.—A REVISION OF THE GENERA *CICHLA*, *CHÆTOBRANCHUS*,
AND *CHÆTOBRANCHOPSIS*.

CICHLA.

Cichla, Schneider, Bloch's Syst. Ichth. p. 340 (1801); Cuv. Règne Anim. ii. p. 279 (1817); Heck. Ann. Mus. Wien, ii. 1840, p. 408; Günth. Cat. Fish. iv. p. 303 (1862); Eigenm. & Bray, Ann. Ac. N. York, vii. 1894, p. 611; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 183 (1904).

* My papers dealing with the American Cichlidæ have been published as follows:—Proc. Zool. Soc. 1905, i. pp. 152-168, pls. xiv. & xv. (*Crenacara*, *Batrachops*, and *Crenicichla*); Ann. & Mag. Nat. Hist. (7) xv. 1905, pp. 329-347 (*Acara*, *Nannacara*, *Acaropsis*, and *Astronotus*); t. c. pp. 557-558 (*Acara subocularis*); ib. xvi. 1905, pp. 60-77, 225-243, 316-340 (*Cichlosoma*); t. c. pp. 433-445 (*Petenia*, *Herichthys*, *Paraneotroplus*, *Neotroplus*, *Herotilapia*, *Uaru*, *Symphysodon*, and *Pterophyllum*); ib. xvii. 1906, pp. 49-66 (*Retroculus*, *Geophagus*, *Heterogramma*, and *Biotocetus*).

Body moderately elongate, compressed; scales small, ctenoid. Two lateral lines, which may sometimes be united; scales of the lateral line not enlarged. Mouth rather large; lower jaw projecting; maxillary nearly completely sheathed by the præorbital; a band of small pointed teeth in each jaw; upper surface of head to between the orbits, cheeks and opercular bones scaly; præoperculum entire. Gill-rakers moderately long, in moderate number (15–18 on the lower part of anterior arch). Dorsal fin with a deep notch between spinous and soft portions, with XIII–XV, I 15–18 rays. Anal with III 10–11 rays. Pectoral asymmetrical, pointed, with 15 or 16 rays; ventrals below the base of the pectorals. Caudal slightly emarginate in the young, truncate or subtruncate in the adult.

Three species from Brazil, Guiana and Venezuela.

Skeleton.

In *Cichla ocellaris* the supraoccipital crest is very strongly developed and extends to the anterior extremity of the frontals, where it bifurcates to form the posterior margin of the cavity for the præmaxillary processes. The parietal crests are well developed and extend forwards on the frontals to the level of the middle of the orbit. The vertebral column consists of 18 præcaudal and 17 caudal vertebrae; parapophyses are developed on the fourth and succeeding vertebrae and become longer and more downwardly directed posteriorly, the last four pairs being bridged to form a closed hæmal canal; the first four ribs are sessile, the rest are inserted on the parapophyses; the epipleurals, except those of the two anterior ribless vertebrae, are attached either to the ribs or to the parapophyses; the third vertebra bears a pair of very small inferior apophyses. The pelvic bones do not diverge anteriorly. The lower pharyngeal bones are united by a straight suture anteriorly, but diverge posteriorly; corresponding to the incomplete union of the lower pharyngeals, the third and fourth upper pharyngeals on each side are separate from each other.

Synopsis of the Species.

I. Origin of dorsal above axil of pectoral.

Scales 83–102 $\frac{9-12}{23-28}$	1. <i>ocellaris</i> .
Scales 104–121 $\frac{12-14}{32-36}$	2. <i>temensis</i> .

II. Origin of dorsal above posterior part of pectoral .. 3. *multifasciata*.

1. *Cichla ocellaris*.

Cichla ocellaris, Schneider, Bloch's Syst. Ichth. p. 340 (1801); Müll. & Trosch. in Schomb. Guiana, iii. p. 625 (1848); Günth. Cat. Fish. iv. p. 304 (1862); Steind. Deutschr. Ak. Wien, xlvi. 1883, p. 3, pl. i. fig. 2; Eigenm. & Bray, Ann. Ac. N. York, vii. 1894, p. 611; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 184 (1904).

Cichla monoculus, Agass. in Spix, Pisc. Bras. p. 100, pl. lxiii. (1829); Heck. Ann. Mus. Wien, ii. 1840, p. 408; Schomb. Fish. Guiana, ii. p. 197, pl. xxvi.

Cichla orinocensis, Humboldt, Obs. Zool. ii. p. 167, pl. xlv. fig. 3 (1833); Schomb. t. c. p. 199, pl. xxvii.

Cichla atabapensis, Humboldt, t. c. p. 168 (1833).

Cichla argus, Val. in Humboldt, t. c. p. 169; Schomb. t. c. p. 149, pl. viii.

Cichla nigromaculata, Schomb. t. c. p. 147, pl. vii.

Cichla trifasciata, Schomb. t. c. p. 151, pl. ix.

Acharnes speciosus, Müll. & Trosch. t. c. p. 622, and Hor. Ichth. p. 27, pl. v. fig. 3 (1849); Günth. o. c. iii. p. 369 (1861).

Crenicichla orinocensis, Günth. t. c. p. 309.

Cichla ocellaris, var. *argus*, Pellegr. Bull. Mus. Paris, 1902, p. 183.

Depth of body equal to or greater than the length of head, about 3 in the length. Diameter of eye $3\frac{1}{4}$ – $5\frac{1}{2}$ in the length of head, length of snout $2\frac{3}{4}$ – $3\frac{1}{3}$, depth of præorbital $4\frac{1}{3}$ – $6\frac{1}{2}$, interorbital width $3\frac{1}{4}$ – $3\frac{3}{4}$. Maxillary extending nearly to below middle of eye (young) or well beyond it (adult). 15–17 gill-rakers on the lower part of anterior arch. Scales 83 – 102 ^{$\frac{9-12}{23-28}$} . Dorsal XIII–XV, I 16–18, commencing above the axil of pectoral, the third and fourth or fourth and fifth spines the longest, $\frac{1}{3}$ – $\frac{2}{3}$ the length of head; the soft fin scaleless. Anal III 10–11, covered with scales in the adult. Pectoral $\frac{3}{4}$ – $\frac{5}{6}$ the length of head. Caudal slightly emarginate in the young, truncate or subtruncate and covered with scales in the adult. Caudal peduncle $1\frac{1}{3}$ – $1\frac{3}{4}$ as long as deep. Brownish or olivaceous, with 3 or 4 broad dark cross-bars on the upper part of the body and an ocellus on the upper part of the base of caudal; cross-bars sometimes replaced by large ocelli; sometimes a series of small blackish spots which are covered by the pectoral fin; vertical fins with alternate light and dark spots.

Brazil; Guiana.

1, 2. (410 and 220 mm.)	Brit. Guiana.	Sir R. Schomburgk.
3. (390 mm.)	Cudaja.	Prof. A. Agassiz.
4. (97 mm.)	—?	Zool. Soc.
5. (173 mm.)	—?	

The above are the specimens on which my description is based; in addition there are 28 specimens, all about 60 mm. in total length, from Teffé, collected by Dr. Bach. In colour

these are olivaceous above, silvery below; a blackish stripe extends from the middle of the side to the extremity of caudal and is usually continued forward by a series of 2 or 3 spots. In some specimens there are 2 or 3 faintly marked dark cross-bars passing through the spots above mentioned.

2. *Cichla temensis*.

? *Perca brasiliensis*, Bloch, Ausl. Fische, vi. p. 84, pl. cccx. fig. 2 (1792).

? *Cichla brasiliensis*, Schneider, Bloch's Syst. Ichth. p. 339 (1801).

Cichla temensis, Humb. Obs. Zool. ii. p. 169 (1833); Heck. Ann. Mus. Wien, ii. 1840, p. 413; Günth. Cat. Fish. iv. p. 304 (1862); Bleek. Versl. Ak. Amst. vii. 1873, p. 32; Steind. Denkschr. Ak. Wien, xlv. 1883, p. 3, pl. i. fig. 3; Eigenm. & Bray, Ann. Ac. N. York, vii. 1894, p. 611; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 185 (1904).

Cichla tucunare, Heck. t. c. p. 409.

Cichla flavomaculata, Schomb. Fish. Guiana, ii. p. 145, pl. vi. (1843).

Cichla conibos, Casteln. Anim. Am. Sud. Poiss. p. 18, pl. x. fig. 3 (1855); Günth. t. c. p. 305.

Depth of body equal to or less than the length of head, $3\frac{1}{3}$ – $3\frac{2}{3}$ in the length. Diameter of eye $4\frac{2}{3}$ – $5\frac{1}{2}$ in the length of head, length of snout $2\frac{2}{3}$ –3, depth of præorbital $4\frac{1}{4}$ – $5\frac{1}{3}$, interorbital width $3\frac{1}{3}$ –4. Maxillary extending to below middle of eye. 16–18 gill-rakers on the lower part of anterior arch. Scales 104–121^{12–14}_{32–36}. Dorsal XIV–XV, I 15–17, commencing above the axil of pectoral, the third and fourth or fourth and fifth spines the longest, from more than $\frac{1}{3}$ to more than $\frac{2}{3}$ the length of head; the soft fin scaleless. Anal III 10–11, covered with scales in the adult. Pectoral $\frac{2}{3}$ – $\frac{4}{5}$ the length of head. Caudal slightly emarginate in the young, truncate and covered with scales in the adult. Caudal peduncle $1\frac{2}{3}$ –2 as long as deep. Brownish, with three dark cross-bars on the upper part of the body and an ocellus on the upper part of the base of caudal; cross-bars sometimes represented by 1 or 2 series of large ocelli; body and vertical fins usually covered with series of light spots; sometimes an oblique dark stripe in front of the eye and a horizontal stripe or series of spots behind it.

R. Amazon; R. Orinoco.

1-2. (245 and 360 mm.)

3. (217 mm.)

4. (355 mm.)

5. (237 mm.)

R. Capin.

R. Cupai.

Tabajas.

Santarem.

Prof. A. Agassiz.

Paris Mus.

In addition to the above specimens, on which my description is based, there are two, 60 and 65 mm. in total length, from Santarem, collected by Messrs. Austen and Cambridge.

These are olivaceous above, silvery below, with a dark stripe from eye to middle of caudal; 3 faint cross-bars pass through 3 blackish spots on the lateral stripe. This is very nearly the coloration of *C. brasiliensis*, Bl., which I believe may be founded on young examples of this species. Certainly none of the species of *Crenicichla* which have been referred to *C. brasiliensis* resemble it to anything approaching the degree that these young examples of *C. temensis* do.

3. *Cichla multifasciata*.

Cichla toucoumarai (non *Cichla tucunare*, Heck.), Casteln. Anim. Am. Sud, Poiss. p. 17, pl. x. fig. 1 (1855).

Cichla multifasciata, Casteln. o. c. p. 18, pl. x. fig. 2; Günth. Cat. Fish. iv. p. 305 (1862).

Castelnau's figures certainly suggest that a distinct species of *Cichla* inhabits the Peruvian Amazon, differing from the two preceding species in the more slender body, the more backward position of the dorsal fin, which commences above the posterior part of the pectoral, and in having more than 3 or 4 dark cross-bars on the upper part of the body.

CHÆTOBRANCHUS.

Chaetobranchus, Heck. Ann. Mus. Wien, ii. 1840, p. 401; Günth. Cat. Fish. iv. p. 310 (1862); Steind. Sitzb. Ak. Wien, lxxi. 1875, p. 128; Eigenm. & Bray, Ann. Ac. N. York, vii. 1894, p. 609; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 200 (1904).

Body of moderate length, compressed; scales large, ctenoid. Two lateral lines. Mouth moderate; lower jaw slightly projecting; maxillary nearly completely sheathed by the præorbital; a narrow band of small pointed teeth in each jaw; upper surface of head to between the orbits, cheeks, and opercular bones scaly; præoperculum entire. Gill-rakers very long, slender and numerous (60 or more on the lower part of anterior arch). A single dorsal, without notch between spinous and soft portions, with XIII-XIV 13-15 rays. Anal with III 10-15 rays. Pectoral asymmetrical, pointed, with 14 to 16 rays; ventrals below the base of the pectorals. Caudal rounded or truncate.

Two species from the Amazon and Guiana.

Synopsis of the Species.

- | | |
|---|---------------------------|
| 2 scales between last dorsal spine and lateral line | 1. <i>flavescens</i> . |
| 4 scales between last dorsal spine and lateral line | 2. <i>semifasciatus</i> . |

1. *Chætobranchus flavescens*.

Chætobranchus flavescens, Heck. Ann. Mus. Wien, ii. 1840, p. 402; Günth. Cat. Fish. iv. p. 310 (1862); Steind. Sitzb. Ak. Wien, lxxi. 1875, p. 128, pl. vi.; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 200 (1904).

Chætobranchus brunneus, Heck. t. c. p. 405; Günth. l. c.

Chromys ucayalensis, Casteln. Anim. Am. Sud, Poiss. p. 15, pl. vi. fig. 2.

Acara ucayalensis, Günth. t. c. p. 281.

Chætobranchus robustus, Günth. t. c. p. 310.

Geophagus badiipinnis, Cope, Proc. Ac. Philad. 1871, p. 251, pl. xi. fig. 1, and Proc. Am. Phil. Soc. xvii. 1878, p. 697; Pellegr. t. c. p. 190.

Depth of body $2-2\frac{2}{3}$ in the length, length of head $2\frac{4}{5}$. Diameter of eye 4 in the length of head, length of snout $3\frac{1}{5}$, depth of præorbital $4\frac{1}{2}-4\frac{2}{3}$, interorbital width $2\frac{1}{2}$. Maxillary extending to below anterior margin of eye. Cheek with 5 or 6 series of scales. Scales $27-29 \frac{3\frac{1}{2}-4}{11}$, 2 between last dorsal spine and lateral line. Dorsal XIII 13-14, the spines increasing in length to the last, which is nearly $\frac{1}{2}$ the length of head. Anal III 11-12. Pectoral extending beyond middle of anal. Caudal peduncle $\frac{1}{2}-\frac{2}{3}$ as long as deep. Olivaceous; a large dark blotch on the middle of the side; vertical fins with alternate light and dark stripes.

R. Amazon; Guiana.

1. (268 mm.)

Brit. Guiana.

Sir R. Schomburgk.

2. (253 mm.)

Tefé.

Prof. A. Agassiz.

2. *Chætobranchus semifasciatus*.

Chætobranchus semifasciatus, Steind. Sitzb. Ak. Wien, lxxi. 1875, p. 130, pl. vii.; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 201 (1904).

Depth of body less than 2 in the length, length of head $2\frac{3}{4}$. Diameter of eye $3\frac{3}{4}$ in the length of head, length of snout $3\frac{1}{5}$, depth of præorbital $4\frac{2}{3}$, interorbital width $2\frac{1}{4}$. Maxillary extending to below anterior margin of eye. Cheek with 4 series of scales. Scales $31 \frac{6}{12}$, 4 between last dorsal spine and lateral line. Dorsal XIV 15 (XIII 14), the spines subequal from the fifth, the last nearly $\frac{1}{2}$ the length of head. Anal III 14 (15). Pectoral extending beyond middle of anal. Caudal peduncle $\frac{2}{3}$ as long as deep. Olivaceous, with 4 more or less distinct dark cross-bars on the upper part of the body; an ocellus on the upper part of the base of caudal; vertical fins with alternate light and dark stripes.

R. Amazon.

1. (188 mm.)

Hyanuary.

Prof. A. Agassiz.

CHÆTOBRANCHOPSIS.

Chætobranchus (part.), Steind. Sitzb. Ak. Wien, lxxi. 1875, p. 128.

Chætobranchopsis, Steind. t. c. p. 133; Eigenm. & Bray, Ann. Ac. N. York, vii. 1894, p. 609; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 201 (1904).

Closely allied to *Chætobranchus*, but with more than 3 anal spines.

A single species from the Amazon.

Chætobranchopsis orbicularis.

Chætobranchus (*Chætobranchopsis*) *orbicularis*, Steind. Sitzb. Ak. Wien, lxxi. 1875, p. 133.

Chætobranchopsis orbicularis, Eigenm. & Bray, Ann. Ac. N. York, vii. 1894, p. 610; Pellegr. Mém. Soc. Zool. France, xvi. 1903, p. 202 (1904).

Depth of body $1\frac{2}{3}$ in the length, length of head $2\frac{1}{2}$. Snout shorter than eye, the diameter of which is 3 in the length of head, interorbital width $2\frac{2}{5}$. Depth of præorbital less than $\frac{1}{2}$ the diameter of eye. Maxillary extending to below anterior margin of eye. Scales $27\frac{4}{11}$. Dorsal XVI 13 (XV–XVI 11–13), the spines increasing in length to the last, which is $\frac{3}{5}$ the length of head; soft fin scaly at the base. Anal VI 16 (13–16). Pectoral extending nearly to posterior end of base of anal. Caudal truncate. Caudal peduncle very short. Olivaceous, with traces of darker cross-bars; a dark blotch on the middle of the side of the body; vertical fins with alternate light and dark stripes or series of spots.

R. Amazon.

1. (83 mm.)

Marajo Is.

Paris Mus.

II.—NOTES ON THE GENERA OF AMERICAN CICHLIDÆ.

The diagnostic characters are shown in the following synopsis:—

I. A notch between spinous and soft portions of dorsal fin; anal fin with 3 spines; teeth conical 1. *Cichla*.

II. No notch between spinous and soft portions of dorsal fin; gill-rakers very long and slender, numerous; teeth conical.

Anal fin with 3 spines 2. *Chætobranchus*.

Anal fin with more than 3 spines 3. *Chætobranchopsis*.

III. No notch between spinous and soft portions of dorsal fin; gill-rakers short or of moderate length, in small or moderate number.

A. Anal fin with 3 spines; teeth conical.

1. Præoperculum finely denticulated.

Dorsal XIV–XVII 8–9; jaws equal anteriorly.. 4. *Crenacara*.

- Dorsal XXII-XXIV 10-13; lower jaw projecting; none of the teeth depressible 5. *Batrachops*.
Dorsal XVI-XXV 11-19; lower jaw projecting; inner teeth depressible 6. *Crenicichla*.
2. Præoperculum entire; no lobe on the anterior branchial arch.
a. Soft vertical fins scaleless or scaly at the base only. Dorsal XIII-XVI 7-12. Anal III 6-11.
a. Maxillary not exposed; præmaxillaries moderately protractile.
- Upper lateral line well separated from spinous dorsal fin 7. *Acara*.
Upper lateral line, for most of its length, separated by only $\frac{1}{2}$ a series of scales from the dorsal fin 8. *Nannacara*.
β. Maxillary exposed; præmaxillaries very protractile.
9. *Acaropsis*.
b. Soft vertical fins covered with scales. Dorsal XII-XIV 19-21. Anal III 15-16 10. *Astronotus*.
3. Præoperculum entire; a compressed lobe on the upper part of the anterior branchial arch.
a. Upper gill-rakers of the outer series of the first branchial arch running at the base of the lobe. 11. *Retroculus*.
b. Gill-rakers of the outer series of the first branchial arch, when developed, continued on to the free edge of the lobe.
- Dorsal XII-XIX 9-14; upper lateral line well separated from spinous dorsal fin 12. *Geophagus*.
Dorsal XV-XVI 5-7; upper lateral line, if complete, separated from the dorsal fin, for most of its length, by only $\frac{1}{2}$ a series of scales 13. *Heterogramma*.
Dorsal VII-VIII 14-15 14. *Biotocus*.
- B. Anal fin with more than 3 spines.
1. Dorsal XIII-XX 10-16. Anal IV-XII 7-16.
a. Teeth all conical or cylindrical, not compressed.
Præmaxillary processes shorter than the head .. 15. *Cichlosoma*.
Præmaxillary processes as long as the head 16. *Petenia*.
b. A band of small conical teeth, with an outer series of larger compressed teeth 17. *Herichthys*.
c. Teeth all rather broad and strongly compressed; scales large, those of the lateral line of the same size as the others.
- Teeth entire, with pointed or rounded apices .. 18. *Paraneetroplus*.
Teeth entire, with truncate apices 19. *Neetroplus*.
Median teeth of outer series entire, truncate; others tricuspid 20. *Herotilapia*.
d. Teeth slender, compressed, pointed in the young, rounded in the adult; scales rather small, those of the lateral line larger than the others 21. *Uuru*.
2. Dorsal VIII-XIII 24-31. Anal V-IX 24-32. Teeth conical.
Teeth confined to the anterior part of each jaw.. 22. *Symphysodon*.
Teeth extending on to the sides of the jaws 23. *Pterophyllum*.

The probable relationships of the genera may be expressed diagrammatically thus:—



The 23 genera comprise 149 species, of which 85 are South American. The exclusively South-American genera are *Cichla* (3 species), *Chætobranchus* (2), *Chætobranchopsis* (1), *Crenacara* (2), *Batrachops* (5), *Crenicichla* (16), *Nannacara* (1), *Acaropsis* (1), *Astronotus* (1), *Retroculus* (1), *Heterogramma* (5), *Biotoecus* (1), *Uaru* (1), *Symphysodon* (1), and *Pterophyllum* (2). *Acara* has 18 species in South America and 1 in Panama, *Geophagus* 11 in South America and 1 in Panama, and *Cichlosoma* 13 species in South America, 53 in Mexico and Central America, 1 in Cuba and 1 in Barbadoes. The remaining genera all pertain to Mexico and Central America, one species of *Herichthys* reaching Texas. They are *Pet-nia* (1 species), *Herichthys* (3), *Paraneotroplus* (1), *Neotroplus* (1), and *Herotilapia* (1).

It is interesting to note that not one of the genera with 3 anal spines is found north of the Isthmus of Panama and that all the South-American forms have simple conical teeth. The South-American species with more than 3 anal spines are either those species of *Cichlosoma* which come nearest to *Acara* or else may usually be regarded as directly modified from them, whilst the genera peculiar to Mexico and Central America are exaggerations of the types of *Cichlosoma* found there.

With the exception of *Cichla*, and possibly of *Chætobranchus*, *Acara* is the starting-point for the evolution of the genera inhabiting South America; of these *Cichlosoma* only has reached Central America and Mexico, and has there given rise to a variety of still more specialized forms, very few of which have again spread southwards*.

When we consider that the Cichlid fauna of Mexico and Central America has undoubtedly been derived from South America, that the most primitive South-American genus, *Acara*, is scarcely generically distinct from the African *Paratilapia* and that there is no reason to believe that the Cichlids have ever been other than a freshwater group, we may find in them considerable support for the view that there was a land-connexion between South America and Africa in Eocene times.

Priscacara, from the Eocene of Wyoming and Utah, has been regarded as a Cichlid, but it has not the reduced number of branchiostegals nor the toothless palate which characterize all living Cichlidae, and appears to me to have no bearing on their geographical distribution.

* *Cichlosoma ornatum* and *C. Festeæ* from W. Ecuador, *C. Kraussi* from Colombia and Venezuela, and *C. spectabile* from the Amazon belong to Central-American types.