

rather more ochraceous than back. Eyes surrounded by well-marked white rings. Chin and interramia prominently white. Ears of medium length, the proectote not or scarcely blackened at the edge terminally, extreme edges white; metentote whitish. Nuchal patch large, projected backwards mesially, prominently contrasted deep rich hazel. Hands and feet white above, with an inconspicuous edging of cinnamon externally. Tail apparently like back above, whitish below, but a good example is not present on any one of these skins.

Skull not unlike that of *S. margaritæ*, with similarly broadened postorbital processes, narrow palatal bridge, with tendency to a posterior median spine; palatal foramina broadened mesially and ending behind opposite the middle of the anterior premolar. Bullæ rather large for the group.

Dimensions of the type (measured on skin):—

Head and body (approximate) 420 mm.; hind foot 77; ear 53.

Skull: greatest length 76; condylo-incisive length 67; zygomatic breadth 34; nasals (oblique) 31; interorbital breadth 18; front of incisor to back of m^3 38; palatal foramina, length 20, breadth at middle 6.2, behind 4.5; palatal bridge 6.5; cheek-tooth series (alveoli) 14.7.

Hab. Purificacion, Magdalena Valley, S.W. of Bogota.

Type. Adult female. B.M. no. 19.10.15.3. Received in exchange from Frère Apollinaris Maria. Three specimens.

This cotton-tail is one of a considerable number of species known from Colombia and Venezuela which are all rather closely allied, but it differs from all by its conspicuously paler coloration. Superficially it most resembles *S. margaritæ*, but is, of course, geographically distant from that animal.

The three specimens are all absolutely alike.

III. — *The Classification of the Fishes of the Family Cichlidæ.*—I. *The Tanganyika Genera.* By C. TATE REGAN, M.A., F.R.S.

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IN his 'Catalogue of African Freshwater Fishes' (iii. p. 134, 1915) Boulenger has written of the Cichlidæ: "The classification of the very numerous African members of this family presents the greatest difficulties, and the division into genera, as here followed, is unsatisfactory and open to criticism, the

dentition in certain species being subject to variation, according to age, or even of a purely individual nature." These remarks led me to undertake a study of the osteology of the African Cichlidæ, in the hope of arriving at more precise definitions of the genera and a more natural arrangement. This task was greatly facilitated by the fact that the large series of skeletons prepared under Boulenger's direction was available for study. It has seemed convenient to limit this paper to the Tanganyika genera, but a brief summary of the general results may be given.

The character of most importance in classification is the structure of the apophysis that supports the upper pharyngeals; the majority of the African Cichlidæ may be divided into those with the pharyngeal apophysis formed by the parasphenoid only (*Tilapia* type), and those in which the apophysis is formed by the parasphenoid in the middle and the basioccipital at the sides (*Haplochromis* type). Each of Boulenger's three largest genera (*Tilapia*, *Paratilapia*, and *Pelmatochromis*) contains species of both groups, and the majority of the species in each with the *Haplochromis* type of apophysis may be added to *Haplochromis*, which thus becomes the largest African genus. Most of the other genera can be definitely assigned a position as either related to *Tilapia* (*Paratilapia*, *Pelmatochromis*, *Hemitilapia*, etc.) or to *Haplochromis* (*Hemichromis*, *Champsocromis*, etc.). All the American Cichlidæ (except *Cichla*, which resembles *Haplochromis*) have the pharyngeal apophysis formed as in *Tilapia*.

In order to give satisfactory definitions and to express the apparent relationships some new genera must be created.

Synopsis of the Tanganyika Genera.

- I. Posterior part of parasphenoid with a strong apophysis ending in a flattish triangular or broadly ovate surface for articulation of upper pharyngeals.

Teeth in jaws conical. D. XIII-XVI 12-17.

A. III 7-9. Scales 30-60; lower lateral line extending far forward..... 1. *Tylochromis*.

- II. Posterior part of parasphenoid slightly or moderately raised, bearing a pair of more or less distinct circular or oval facets for articulation of upper pharyngeals.

A. Mouth terminal; teeth in jaws pluriserial, all tricuspid, or outer mostly bicuspid. Ethmoid unconnected with vomer; inferior apophyses of third vertebra united to form a strong spine. D. XV-XVIII 11-15. A. III 8-11. Scales 31-35.

Outermost series of teeth mostly bicuspid 2. *Tilapia*.
Teeth all slender, tricuspid 3. *Neotilapia*.

B. Mouth terminal or subterminal; jaws with an outer series of enlarged uni- or bicuspid teeth and 2 or more inner series of small tricuspid or compressed teeth. Ethmoid united with vomer by suture; inferior apophyses of third vertebra meeting below but not united. D. XV-XXI 5-12. A. III-VI 5-10. Scales 30-40.

1. D. XV-XX 8-12. A. III 6-10.

- | | |
|---|----------------------------|
| Mouth terminal; outer teeth bicuspid or some conical, inner mostly tricuspid | 4. <i>Limnotilapia</i> . |
| Mouth terminal; teeth compressed, outer bicuspid and inner tricuspid in young, all unicuspid in adult | 5. <i>Lobochilotes</i> . |
| Mouth subterminal; an outer series of curved conical teeth and a band of small tricuspid teeth | 6. <i>Gephyrochromis</i> . |
| Mouth subterminal; præmaxillaries with an outer series of teeth, which are bicuspid anteriorly and conical laterally, followed by a band of small tricuspid teeth | 7. <i>Simochromis</i> . |

2. D. XX-XXI 5-6. A. IV-VI 5-7. Mouth wide, subterminal, with a band of small tricuspid teeth and an outer series of bicuspid teeth; a single series of conical teeth at sides of præmaxillaries..... 8. *Tropheus*.

C. Mouth subterminal or inferior; teeth tricuspid or conical. D. XII-XIV 12-14. A. III 8-10. Scales large, 34 to 40.

- | | |
|---|------------------------------|
| Mouth subterminal; teeth small, fixed, uni- or tricuspid, in narrow bands | 9. <i>Ophthalmotilapia</i> . |
| Mouth subterminal; teeth movable, slender, tricuspid, in broad bands | 10. <i>Cunningtonia</i> . |
| Mouth transverse, inferior; teeth slender, tricuspid | 11. <i>Asprotilapia</i> . |

D. Mouth subterminal; teeth slender, tricuspid, movable, in broad bands. D. XVII-XX 8-10. A. III 7-8. Scales large, 32-35

12. *Petrochromis*.

E. Mouth subterminal; teeth fixed, tricuspid or conical. D. XIII-XIV 12-14. A. III 9-10. Scales small, 55-65.

13. *Cyathopharynx*.

F. Mouth terminal; teeth conical. D. XII-XIX 8-16. A. III 7-12. Scales large, 28-42.

- | | |
|---|---------------------------|
| Maxillary slightly exposed; interorbital region flattish; occipital crest not extending forward beyond middle of orbits | 14. <i>Limnochromis</i> . |
|---|---------------------------|

- | | |
|--|---------------------------|
| Maxillary considerably exposed; frontal region humped; occipital crest extending forward at least to anterior end of interorbital region | 15. <i>Cyphotilapia</i> . |
|--|---------------------------|

G. Mouth terminal. D. XVI-XVIII 10-15. A. III 8-10. Scales small, 65 to 90.

Teeth small, in 4 or 5 series, cuspidate in the young, conical in the adult 16. *Boulengerochromis*.

Teeth large, uniserial, stout, with a small cusp on each side superiorly 17. *Perissodus*.

III. Articular surface for upper pharyngeals formed by parasphenoid in the middle and basioccipital at the sides.

A. Scales large; 3 anal spines; teeth small or moderate.

1. One or two lateral lines; outermost pelvic ray longest.

a. Bones of head with small canals ending in small pores.

a. Inferior apophyses of third vertebra well developed.

An outer series of bicuspid or conical teeth and one or more inner series of smaller tricuspid or conical teeth; pharyngeal teeth bicuspid or conical 18. *Haplochromis*.

An outer series of small conical teeth, those of lower jaw directed outwards, and one or more inner series of minute conical teeth; lower pharyngeal teeth small, slender.... 19. *Ectodus*.

An outer series of small conical teeth, those of lower jaw directed more or less outwards; middle teeth of posterior part of lower pharyngeal enlarged and obtuse 20. *Callochromis*.

β. Inferior apophyses of third vertebra vestigial; an outer series of small conical teeth and 1 or 2 inner series of minute teeth 21. *Leptochromis*.

b. Frontals, nasals, præorbitals, lower jaw, and præoperculum with large channels with wide openings.

Suborbitals narrow; 2 lateral lines 22. *Aulonocranus*.

Suborbitals broad, deeply excavated; one short lateral line 23. *Trematocara*.

2. Two lateral lines; innermost pelvic ray longest.

Outer teeth of lower jaw erect 24. *Stappersia*.

Outer teeth of lower jaw directed outwards .. 25. *Enantiopus*.

3. Three lateral lines.

Outermost pelvic ray longest 26. *Grammatotria*.

Innermost pelvic ray longest 27. *Xenotilapia*.

B. Scales small; 3 anal spines.

1. Teeth in 2 to 5 series, conical.

Mouth moderate; teeth small 28. *Hemibates*.

Mouth large; teeth strong 29. *Bathybates*.

2. Teeth uniserial.

a. Teeth conical, curved 30. *Haplotaxodon*.

b. Teeth compressed, strongly curved.

Teeth small, close-set 31. *Xenochromis*.

Teeth large, set well apart 32. *Plecodus*.

C. Scales large; 3 anal spines; teeth strong, compressed.

Teeth bi- or triserial, distally expanded and truncate 33. *Eretmodus*.

Teeth uniserial, distally slightly expanded and rounded 34. *Spathodus*.

D. Scales large or small; 4 to 10 anal spines; a band of small teeth and an outer series of conical teeth, the anterior strong.

1. Inner teeth tricuspid 35. *Telmatochromis*.

2. Inner teeth conical; suborbitals ligamentous. 36. *Julidochromis*.

3. Inner teeth conical; suborbitals ossified. 37. *Lamprologus*.

1. TYLOCHROMIS, gen. nov.

(type *Pelmatochromis jentinki*, Steind.).

Dorsal XIII-XVI 12-17. Anal III 7-9. Scales cycloid or finely denticulate, large or rather small (30-60); two lateral lines, the lower extending far forward. Mouth terminal; teeth conical, in 2 to 5 series. Lower pharyngeal triangular, with slender pointed teeth at least near the posterior angles and large rounded flat teeth in the middle at least posteriorly. Posterior part of parasphenoid with a strong apophysis ending in a flattish triangular or broadly ovate surface for articulation of upper pharyngeal. Vertebrae 29-32 (15-16 + 14-16); third with inferior apophyses uniting to form a strong median spine.

Tanganyika; Congo; Gambia to Liberia.

The Tanganyika species (*T. polylepis*) differs from its congeners in the smaller scales (55 to 60 instead of 30 to 45).

2. TILAPIA, A. Smith, 1840 (type *T. sparrmanni*, A. Smith).

Dorsal XI-XVIII 9-16. Anal III-IV (V-VI) 7-12. Scales cycloid or feebly denticulate, large (26-36); two lateral lines. Mouth terminal; maxillary concealed or slightly exposed distally; teeth in jaws in several series, the outermost typically bicuspid (some often uni- or tricuspid), rarely all conical; inner series typically tricuspid, some occasionally unicuspid in adults. Lower pharyngeal triangular or heart-shaped, with slender or moderately stout uni-, bi-, or tricuspid teeth. Occipital crest extending forward to posterior end of a median excavation of anterior part of frontals; parietal crests extending forwards at least to between the orbits; nasal bones strongly expanded posteriorly; premaxillary processes stout, much expanded

proximally, not or barely reaching frontals; posterior part of parasphenoid more or less distinctly raised, bearing a pair of transverse oval facets for articulation of upper pharyngeals. Vertebrae 26–33 (14–17 + 12–16); third with a pair of inferior apophyses which unite below; præcaudals with parapophyses from the fourth, the last or last two pairs each connected by a bridge; ribs, except the first, on parapophyses.

Africa and Syria.

As restricted by the above definition this is a large and varied genus, which nearly corresponds to Boulenger's section I. (scales cycloid or feebly denticulate) with the exception of *T. auromarginata* *. A complete revision will be necessary before a final decision can be reached as to whether it should be split up. At present I am inclined to recognize four subgenera, as follows:—

I. Lower pharyngeal with short anterior blade.

- | | |
|---|-----------------------|
| Ethmoid united with vomer by suture | <i>Coptodon</i> . |
| Ethmoid free from vomer; maxillary concealed; inner edges of rami of lower jaw curved anteriorly; pharyngeal teeth slender | <i>Tilapia</i> . |
| Ethmoid free from vomer; outer teeth of jaws much expanded; end of maxillary exposed; inner edges of rami of lower jaw straight; middle pharyngeal teeth rather stout | <i>Heterotilapia</i> |
| II. Lower pharyngeal with long anterior blade; | |
| maxillary concealed; inner edges of mandibular rami curved anteriorly; pharyngeal teeth small, slender, numerous | <i>Sarotherodon</i> . |

Of these subgenera *Coptodon* includes *T. zillii* and *T. busumana*, *Heterotilapia* is a new subgenus formed for *T. buettikoferi*, which has a very characteristic dentition; the stout pharyngeal teeth are bicuspid, with the posterior cusp large and obtuse and the anterior represented by a transverse ridge which may bear 2 or 3 denticles. *Sarotherodon* (*Melanogenes*, *Oreochromis*) includes the species of the *shirana*, *nilotica*, *galilæa*, and *macrocephala* groups. A species of this subgenus (*T. nilotica*) has reached Tanganyika, probably through Lake Kivu.

3. NEOTILAPIA, gen. nov.

(type *Chromis tanganicæ*, Günth.).

Dorsal XVI–XVII 11–13. Anal III 9–10. Scales

* *Otopharynx*, gen. nov. (type *T. auromarginata*, Bouleng.); differs from *Tilapia* in that the prootic forms part of the pharyngeal facet on each side; very near *Chilotilapia*.

cycloid, large (32-34); two lateral lines. Mouth terminal; teeth very slender, tricuspid, in broad bands. Lower pharyngeal with long anterior blade; dentigerous area broadly heart-shaped; teeth small, slender, numerous. Occipital and parietal crests extending forward nearly to anterior end of frontals; parietal crests mid-way between occipital crest and orbital margin; ethmoid well separated from vomer; nasal bones strongly expanded posteriorly; posterior part of parasphenoid raised, bearing a pair of nearly circular facets for articulation of upper pharyngeals. Vertebrae 31 (17+14); inferior apophyses of third united below to form a strong spine.

Tanganyika; two species.

The resemblance in external characters to *T. nilotica* and *T. galilæa* extends to every detail of the skeleton.

4. LIMNOTILAPIA, gen. nov. (type *Tilapia dardennii*, Bouleng.).

Dorsal XV-XX 9-12. Anal III 8-10. Scales cycloid or finely denticulate, large (32-40); two lateral lines. Mouth terminal, rather small; maxillary not exposed; jaws with an outer series of teeth, all bicuspid or some conical, and one or more inner series of small teeth, all tricuspid or some unicuspid in adult. Lower pharyngeal triangular, with slender uni- or bicuspid teeth; anterior blade short or moderate. Occipital crest extending forward to posterior end of a median anterior excavation of frontals; parietal crests ending above posterior part or middle of orbits, at or near orbital margin; mesethmoid suturally united with vomer: nasal bones moderately expanded posteriorly; præmaxillary processes slender, about reaching anterior edge of frontals; maxillary short and broad, with a large rounded expansion below palatine articulation; rami of lower jaw with straight inner edges; posterior part of parasphenoid slightly raised, bearing a pair of facets for articulation of upper pharyngeals. Vertebrae 33 or 34 (16-17+17); third with a pair of inferior apophyses which meet below, but do not unite; præcaudals with parapophyses from the fourth; each of the last three pairs connected by a bridge; ribs, except the first, on parapophyses.

Tanganyika.

Three species (*L. dardennii*, *pleurotænia*, and *trematocephala*). Very close to *Tilapia*, differing especially in the form of the nasal bones and præmaxillary processes and the structure of the inferior apophyses of the third vertebra; of the species

of *Tilapia* only *T. zillii* and *T. busumana* retain the sutural union of the ethmoid and vomer, and only *T. buettikoferi* has the mandibular rami formed as in *Limnotilapia*.

5. LOBOCHILOTES, Bouleng., 1915 (type *L. labiatus*, Bouleng.).

Dorsal XVII-XIX 9-11. Anal III 6-8. Scales feebly denticulate, large (33-35); two lateral lines. Mouth terminal; lips thick; 3 to 5 series of compressed teeth, outermost bicuspid and inner tricuspid in young, all rounded or truncate, without cusps, in the adult. Lower pharyngeal with slender teeth and with a group of large blunt teeth in the middle posteriorly. Skeleton as in *Limnotilapia dardennii*; vertebræ 32 (15+17).

Tanganyika. A single species.

6. GEPHYROCHROMIS, Bouleng., 1901 (type *G. moorii*, Bouleng.).

Dorsal XVII 8. Anal III 7. Scales feebly denticulate, large (30); two lateral lines. Mouth subterminal, rather wide; jaws with a band of small tricuspid teeth and an outer series of enlarged curved conical teeth, those of the præmaxillaries gradually decreasing in size posteriorly, but the last 2 or 3 on each side again enlarged.

Tanganyika. A single species.

Very near *Limnotilapia* and *Simochromis*.

7. SIMOCHROMIS, Bouleng., 1898 (type *S. diagramma*, Günth.).

Dorsal XVII-XIX 9-10. Anal III 7-9. Scales feebly denticulate, large (33-36); two lateral lines. Mouth subterminal, rather wide; jaws with a band of small tricuspid teeth and an outer series of larger teeth which are bicuspid anteriorly and conical at the sides of the præmaxillaries. Lower pharyngeal triangular, with slender uni- or bicuspid teeth. Vertebræ 32 (15+17). Skeleton as in *Limnotilapia dardennii*.

Tanganyika; a single species.

Simochromis differs from *Limnotilapia* in the form of the mouth and from *Gephyrochromis* in the dentition.

8. TROPHEUS, Bouleng., 1898 (type *T. moorii*, Bouleng.).

Dorsal XX-XXI 5-6. Anal IV-VI 5-7. Scales feebly denticulate, large (28-32). Mouth subterminal, wide, with transverse bands of small tricuspid teeth and a series of larger bicuspid teeth in front of them; sides of præmaxillaries with a series of well-differentiated conical teeth. Vertebrae 33 (17+16). In other characters like *Simochromis*.

Tanganyika; two species.

9. OPHTHALMOTILAPIA, Pellegr., 1904
(type *Tilapia boops*, Bouleng.).

Dorsal XII-XIII 12-14. Anal III 8-10. Scales denticulate, large (34-40); two lateral lines, the upper nearly reaching caudal fin. Eye large; snout short and broad; mouth subterminal, wide, nearly transverse; distal end of maxillary slightly exposed. Teeth in jaws firmly attached, close-set, slender, slightly curved at tip, uni- or tricuspid, in narrow bands; outermost series enlarged. Lower pharyngeal subtriangular, with slender teeth. Parietal crests not extending quite so far forward as occipital crest, which ends above middle of orbits behind a median groove on the frontals which widens out forwards; nasals scarcely broader posteriorly than anteriorly; præmaxillary processes not reaching frontals; maxillary moderately broad; a thin-walled auditory bulla formed by prootic and basioccipital; posterior part of parasphenoid slightly raised, bearing a pair of transverse oval facets for articulation of upper pharyngeals. Vertebrae 34 (16+18); third with a pair of inferior apophyses; præcaudals with parapophyses from third; ribs in sockets at or near ends of parapophyses.

Tanganyika.

Two species, *O. boops* and *O. ventralis* (*Paratilapia ventralis*, Bouleng.), the latter differing from the former in the loss of the lateral cusps of the teeth.

10. CUNNINGTONIA, Bouleng., 1906
(type *C. longiventralis*, Bouleng.).

Dorsal XIII 13-14. Anal III 8-9. Scales denticulate, large (38-43). Differs from *Ophthalmotilapia* in the dentition; teeth in jaws very slender, movable, tricuspid, in rather broad bands.

Tanganyika; a single species.

11. ASPROTILAPIA, Bouleng., 1901
(type *A. leptura*, Bouleng.).

Dorsal XIV 14. Anal III 8. Scales denticulate, large (38); two lateral lines. Snout conical; mouth inferior, transverse; teeth in jaws slender, tricuspid, in narrow transverse bands. Lower pharyngeal subtriangular, with slender teeth. Skeleton essentially similar to that of *Ophthalmotilapia ventralis*, except that the nasal bones are broad posteriorly. Vertebrae 35 (16 + 19).

Tanganyika; a single species.

This genus differs from *Ophthalmotilapia* in the strictly transverse and inferior mouth, with the bands of teeth not extending backwards at the sides.

12. PETROCHROMIS, Bouleng., 1898
(type *P. polyodon*, Bouleng.).

Dorsal XVII–XX 8–10. Anal III 7–8. Scales finely denticulate, large (32–35). Mouth subterminal; lips very thick, the upper with a double fold; teeth very slender, tricuspid, in very broad bands. Lower pharyngeal subtriangular, with moderately long anterior blade. Occipital crest extending forward in advance of parietal crests, which end above middle of orbits near edges of frontals; ethmoid united with vomer by suture; nasal bones not expanded posteriorly; parasphenoid with a pair of facets for articulation of upper pharyngeals. Vertebrae 32 (16 + 16); inferior apophyses of third short, separate.

Two species from L. Tanganyika and one from L. Nyassa.

This genus is essentially similar to *Ophthalmotilapia* in skeletal structure.

13. CYATHOPHARYNX, gen. nov.
(type *Tilapia grandoculis*, Bouleng.).

Dorsal XIII–XIV 12–14. Anal III 9–10. Scales denticulate, small (55–65); two lateral lines, the upper nearly reaching caudal fin. Mouth small, subterminal; maxillary concealed; jaws with 3 to 5 series of slender pointed teeth, with or without small lateral cusps; teeth of the outermost series enlarged, in the lower jaw directed outwards. Lower pharyngeal with nearly circular, slightly concave dentigerous area and rather long anterior blade; teeth numerous, close-set, slender. Occipital crest extending forwards to middle of interorbital region, ending behind a median groove on

frontals; parietal crests ending above posterior part of orbits; ethmoid suturally united with vomer; nasals considerably expanded posteriorly; præmaxillary processes not reaching frontals; maxillary short and broad, broadest below palatine articulation; posterior part of parasphenoid slightly raised, bearing a pair of subcircular facets for articulation of upper pharyngeals. Vertebrae 32-34 (16-17 + 16-17); third without inferior apophyses; præcaudals with parapophyses from the fourth; ribs, except the first, on parapophyses.

Tanganyika.

Two species, *C. grandoculis* and *C. furcifer* (*Paratilapia furcifera*, Bouleng.).

14. LIMNOCHROMIS, gen. nov.

(type *Pelmatochromis auritus*, Bouleng.).

Dorsal XII-XVII 9-16. Anal III 7-12. Scales finely denticulated, large, 32 to 42; two lateral lines. Mouth terminal; maxillary rather narrow, slightly exposed; teeth conical, in 2 to 4 series. Lower pharyngeal triangular; teeth all slender or a few median posterior teeth slightly enlarged. Occipital and parietal crests extending forward to above middle or posterior part of interorbital region; a median groove on frontals in front of occipital crest; nasal bones expanded posteriorly; ethmoid well separated from vomer; præmaxillary processes moderate or long, sometimes extending to between the orbits; posterior part of parasphenoid slightly raised, bearing a pair of transverse oval facets for articulation of upper pharyngeals. Vertebrae 31 (15 + 16) to 37 (19 + 18); third with or without a pair of inferior apophyses which do not meet below.

Tanganyika; four species.

In addition to *L. auritus* this genus includes three species placed by Boulenger in *Paratilapia*—*L. pfefferi*, *nigripinnis*, and *leptosoma*. *L. auritus* and *L. leptosoma* are very similar in their osteology, and the other species are intermediate between them in external characters.

15. CYPHOTILAPIA, gen. nov.

(type *Pelmatochromis frontosus*, Bouleng.).

Dorsal XV-XIX 8-10. Anal III 7-8. Scales cycloid or feebly denticulated, large (28-36); two lateral lines. Frontal region humped. Mouth terminal; maxillary largely exposed; teeth in 3 to 5 series, outermost enlarged, conical or some bicuspid, inner conical or some tricuspid. Lower

pharyngeal triangular, with slender pointed uni- or bicuspid teeth; upper pharyngeals supported by a rather strong apophysis with transverse articular surface formed by the parasphenoid. Occipital crest very strong, extending forwards to or in advance of anterior margin of orbits.

Tanganyika and Upper Congo.

Two species, *C. frontosus* and *C. demeusii* (*Paratilapia demeusii*, Bouleng.).

16. BOULENGEROCHROMIS, Pellegr., 1904
(type *Paratilapia microlepis*, Bouleng.).

Dorsal XVI–XVII 13–15. Anal III 9–10. Scales cycloid, small (75–90); two lateral lines. Mouth terminal; maxillary slightly exposed distally; teeth small, in 4 or 5 series, conical (outer bicuspid and inner tricuspid in the young). Lower pharyngeal subtriangular, with slender bicuspid teeth. Occipital crest extending forward to end of a median excavation of anterior part of frontals; parietal crests confluent with edge of frontals above middle of orbits; ethmoid united with vomer by suture; nasal bones slightly expanded posteriorly; premaxillary processes nearly reaching frontals; maxillary rami rather broad, of even width; posterior end of parasphenoid slightly raised, bearing a pair of transverse facets for articulation of upper pharyngeals. Vertebrae 33 (16+17); third with a pair of inferior apophyses which unite below; praecaudals with parapophyses from fourth; ribs, except the first, on parapophyses.

Tanganyika. A single species.

17. PERISSODUS, Bouleng., 1898 (type *P. microlepis*, Bouleng.).

Dorsal XVIII 10. Anal III 8. Scales cycloid, small (65); two lateral lines. Differs from *Boulengerochromis* in the dentition. Teeth in jaws uniserial, few, stout, with a small cusp on each side superiorly.

Tanganyika. A single species.

18. HAPLOCHROMIS, Hilgend., 1888
(type *Chromis obliquidens*, Hilgend.).

Dorsal XIII–XIX 6–13. Anal III (IV) 6–12. Scales usually denticulate, large (28 to 45); two lateral lines. Mouth terminal; jaws opposed; an outer series of bicuspid or conical teeth and one or more inner series of smaller tricuspid or conical teeth. Lower pharyngeal triangular; teeth

slender or rather stout, compressed or cylindrical, uni- or bicuspid, acute or obtuse. Occipital crest extending forward to posterior end of a median excavation of frontals; parietal crests ending between the orbits; ethmoid suturally united with or in contact with vomer; nasals not or scarcely broader posteriorly than anteriorly. Articular surface for upper pharyngeals transverse, entered by basioccipital at the postero-lateral angles. Vertebrae 29 to 34 (13-17+15-18); third with a pair of inferior apophyses which unite below.

Africa.

This is the largest African genus, including 14 of the 16 species placed by Boulenger in *Haplochromis*, 8 (23-27, 30-32) included by him in *Pelmatochromis*, at least 26 (10-12, 14-29, 37-38, 40-44) of the 53 referred to *Paratilapia*, and the majority of the species with ctenoid scales placed in *Tilapia* *.

Haplochromis is represented in Tanganyika by one of the forms grouped together as *H. desfontainesii* and by two species placed by Boulenger in *Tilapia*, *H. horii* and *H. burtoni*.

19. ECTODUS, Bouleng., 1898 (type *E. descampsii*, Bouleng.).

Dorsal XIII-XIV 13-15. Anal III 8-11. Outermost pelvic rays longest. Scales denticulate, large (34-38); two lateral lines. Mouth small, terminal; maxillary concealed; teeth conical, in narrow bands, outer of lower jaw directed

* The following genera are closely related to *Haplochromis*:—*Lipochromis*, gen. nov. (type *Pelmatochromis obesus*, Bouleng.). Lower jaw shutting within upper. *Neochromis*, gen. nov. (type *Tilapia simotes*, Bouleng.). As *Haplochromis*, but teeth small, in bands, outer not enlarged, bicuspid, inner tricuspid. *Cnestrostoma*, gen. nov. (type *Paratilapia polyodon*, Bouleng.); jaws with broad bands of small conical teeth, outer not enlarged. *Mylochromis*, gen. nov. (type *Tilapia lateristriga*, Günth.); middle pharyngeal teeth large and obtuse, sharply differentiated from the other teeth, which are slender and bicuspid. *Sargochromis*, gen. nov. (type *Paratilapia codringtoni*, Bouleng.). Fourth vertebra with inferior apophyses that meet below; pharyngeal teeth stout and blunt; articular surface for upper pharyngeals nearly as broad as long, its basioccipital portions nearly meeting behind parasphenoid. *Labrochromis*, gen. nov. (type *Tilapia pallida*, Bouleng.); inferior apophyses on third vertebra formed as in *Haplochromis*; pharyngeal teeth and pharyngeal apophysis as in *Sargochromis*. *Serranochromis*, gen. nov. (type *Chromys thumbergi*, Casteln.); as *Haplochromis*, but inferior apophyses on fourth vertebra very small. *Astatoreochromis*, Pellegr. (*allnaudi*); 4 to 6 anal spines; pharyngeal teeth large and obtuse. *Clinodon*, gen. nov. (type *Hemitilapia bayoni*, Bouleng.); structure of *Haplochromis*, dentition of *Hemitilapia*.

outwards. Lower pharyngeal triangular, with small slender teeth. Skeleton very similar to that of *Callochromis macrops*, but the præmaxillary processes shorter, not reaching frontals; vertebræ 36 (17 + 19).

Tanganyika; a single species.

20. CALLOCHROMIS, gen. nov.

(type *Pelmatochromis macrops*, Bouleng.).

Dorsal XII–XVI 10–14. Anal III 6–9. Outermost ray of pelvic fin longest. Scales denticulate, large (32–38); two lateral lines. Mouth small, terminal or subterminal, nearly horizontal; end of maxillary slightly exposed; jaws with narrow bands of small conical teeth, the outer on sides of lower jaw enlarged and directed more or less outwards. Lower pharyngeals united by interlocking suture to form a triangular plate; enlarged blunt rounded teeth in the middle posteriorly and slender bicuspid teeth elsewhere. Occipital crest ending above middle of orbits behind a groove on frontals that widens forwards; parietal crests ending above posterior part of orbits; præmaxillary processes extending to between orbits; maxillary broadest below palatine articulation, distal part short and broad; ethmoid united with vomer by suture; nasals much expanded posteriorly; posterior part of parasphenoid slightly raised, convex; articular surface for upper pharyngeals formed by parasphenoid in the middle and basioccipital at the sides. Vertebræ 34 (16 + 18); inferior apophyses of third vertebra uniting below to form a median spine.

Tanganyika; four species.

21. LEPTOCHROMIS, gen. nov.

(type *Paratilapia calliura*, Bouleng.).

Dorsal XVI–XVII 10. Anal III 7–8. Scales denticulate, large (37–40); two lateral lines. Mouth terminal, very protractile; maxillary broad, slightly exposed; jaws with an outer series of very small conical teeth and 1 or 2 inner series of minute teeth. Interorbital region narrow. Lower pharyngeal small, triangular, with long anterior blade; teeth small, slender. Occipital crest ending at posterior part of interorbital region behind a long groove on the narrow frontals; parietal crests not extending forwards on frontals; ethmoid in contact with vomer; a thin-walled otic bulla; articular surface for upper pharyngeals formed by parasphenoid in the middle and basioccipital at the sides.

Vertebræ 34 (17+17); third with vestigial inferior apophyses; præcaudals with parapophyses from fourth, last four pairs bridged; ribs, except first, in sockets at or near ends of parapophyses.

Tanganyika; a single species.

22. AULONOCRANUS, gen. nov.

(type *Paratilapia dewindti*, Bouleng.).

Dorsal XII–XIII 12–13. Anal III 9. Scales denticulate, large (36–38); two lateral lines. Mouth terminal, moderately protractile; maxillary moderately broad, exposed distally; teeth very small, conical, in 2 or 3 series, outermost largest. Lower pharyngeal triangular; teeth small. Occipital crest ending on posterior part of interorbital region. Frontals, nasals, præorbitals, lower jaw, and lower limb of præoperculum with large channels with wide openings; suborbitals narrow.

Tanganyika; a single species.

Intermediate between *Haplochromis* and *Trematocara*.

23. TREMATOCARA, Bouleng., 1899 (type *T. marginatum*, Bouleng.).

Dorsal IX–XII 9–12. Anal III 7–10. Scales cycloid, large (28–32); upper lateral line short, lower absent. Near *Aulonocranus*, but maxillary concealed, and the deep channeling of the bones of the head extending to the suborbitals. Occipital and parietal crests not extending forwards on frontals; ethmoid united with vomer by suture; a large otic bulla; articular surface for upper pharyngeals formed by parasphenoid in the middle and basioccipital at the sides. Vertebrae 31 (12+19); third without inferior apophyses; præcaudals with parapophyses from the fourth; ribs, except the first, on parapophyses.

Tanganyika; three species.

24. STAPPERSIA, Bouleng., 1914

(type *S. singularis*, Bouleng.).

Dorsal XIII–XV 13–14. Anal III 13–14. Innermost rays of pelvic fins longest. Scales denticulate, large (37–38); two lateral lines. Apparently differs from *Enantiopus* only in the dentition; teeth small, conical, in 4 or 5 series, outer not directed outwards.

Tanganyika; a single species.

25. ENANTIOPUS, Bouleng., 1906
(type *E. melanogenys*, Bouleng.).

Dorsal XII-XV 13-17. Anal III 12-17. Innermost pelvic rays longest. Scales denticulate, large (37-44); two lateral lines. Mouth terminal, very protractile; teeth small, conical, in 2 series, outer of lower jaw directed outwards. Lower pharyngeal triangular; teeth mostly slender, bicuspid, a few middle posterior teeth large and blunt. Occipital and parietal crests ending above posterior part of orbits; frontals with a median groove, widening forwards; mesethmoid well separated from vomer; articular surface for upper pharyngeals formed by parasphenoid in the middle and basioccipital at the sides. Vertebrae 38 (14+24); inferior apophyses of third meeting below.

Tanganyika; 3 or 4 species.

26. GRAMMATOTRIA, Bouleng., 1899 (type *G. lemairii*, Bouleng.).

Dorsal XV 14-15. Anal III-IV 10-11. Outermost pelvic rays longest. Scales denticulate, large, about 40 in a lateral longitudinal series; 3 lateral lines. Mouth terminal; end of maxillary exposed; a series of conical teeth followed by a narrow band of minute teeth; outer anterior teeth of lower jaw directed outwards. Lower pharyngeal triangular; middle posterior teeth strongly enlarged and blunt. Skeleton as in *Callochromis macrops*, except that the frontals partly roof over the median groove from each side and the inferior apophyses of the third vertebra are vestigial. Vertebrae 36 (14+22).

Tanganyika; a single species.

27. XENOTILAPIA, Bouleng., 1899 (type *X. sima*, Bouleng.).

Dorsal XIII-XV 12-14. Anal III 7-12. Innermost pelvic rays longest. Scales denticulate, large (34-41); 3 lateral lines. Mouth terminal, very protractile; maxillary very broad, concealed; teeth small, conical, in 2 or 3 series, outer anterior teeth of lower jaw directed outwards. Lower pharyngeal triangular; middle posterior teeth enlarged and obtuse. Skeleton nearly as in *Callochromis macrops*, but with the frontals tending to roof the median groove as in *Grammatotria*. Vertebrae 34-35 (13-14+20-22).

Tanganyika; two species.

28. HEMIBATES, gen. nov.

(type *Paratilapia stenosoma*, Bouleng.).

Dorsal XV 13. Anal III 12-14. Scales cycloid, small (60-70); two lateral lines, the upper nearly reaching caudal fin. Mouth moderate, terminal, with lateral cleft; maxillary slightly exposed distally; teeth small, conical, curved, in 2 or 3 series, outer erect and fixed, inner pointing backwards, depressible. Lower pharyngeal triangular, with slender teeth. Parietal crests ending at edge of frontals above middle of orbits; occipital crest ending behind a short median depression on anterior part of frontals; nasals somewhat expanded posteriorly; præmaxillary processes reaching frontals; maxillary broadest below palatine articulation, moderately broad distally; base of skull with a low, broad convex apophysis, with articular surface for upper pharyngeals formed in the middle by the parasphenoid, and at the sides by the basioccipital. Third vertebra without inferior apophyses.

Tanganyika; a single species.

29. BATHYBATES, Bouleng., 1898 (type *B. ferox*, Bouleng.).

Dorsal XIII-XVII 11-17. Anal III 14-18. Scales cycloid, small (65-150); two lateral lines, the upper extending nearly to caudal fin. Mouth large, terminal, with lateral cleft; maxillary hidden; teeth strong, curved, conical, in 2 to 4 series, outer fixed, inner depressible. Lower pharyngeal triangular, with slender teeth. Parietal crests ending near edge of frontals above middle of orbit; occipital crest extending as far forward or a little farther, ending behind a median depression on the frontals which widens out anteriorly; ethmoid united with vomer by suture; nasals somewhat expanded posteriorly; præmaxillary processes not reaching frontals; maxillary broadest below palatine articulation, moderately broad distally; base of skull with a low, broad, convex apophysis, with the articular facets for the upper pharyngeals well separated, oblique, formed by the parasphenoid in the middle and the basioccipital at the sides. Vertebrae 35-36 (16-17 + 19-20); third without inferior apophyses.

Tanganyika; six species.

30. HAPLOTAXODON, Bouleng., 1906

(type *H. microlepis*, Bouleng.).

Dorsal XVII-XVIII 11-13. Anal III 9. Scales small (70-80); two lateral lines, the upper nearly reaching caudal

fin. Mouth terminal, very oblique; end of maxillary exposed; teeth uniserial, conical, curved. Lower pharyngeal triangular, with small slender unicuspid teeth. Skeleton as in *Hemibates*, except that the maxillary has only a small process below the palatine articulation and is broadest distally; præmaxillary processes not reaching frontals; vertebræ 38 (19+19).

Tanganyika; a single species.

31. *XENOCHROMIS*, Bouleng., 1899
(type *X. hecqui*, Bouleng.).

Dorsal XVI-XVII 10-11. Anal III 9-10. Scales small (60-70); two lateral lines, the upper nearly reaching caudal fin. Mouth terminal; end of maxillary exposed; teeth uniserial, compressed, a little concave in front, strongly curved, rather small and forming a close-set series. Lower pharyngeal triangular, with small unicuspid teeth. Skeleton as in *Haplotaxodon*, except that the ethmoid is well separated from the vomer. Vertebræ 35 (17+18).

Tanganyika; a single species.

32. *PLECODUS*, Bouleng., 1898
(type *P. paradoxus*, Bouleng.).

Dorsal XVIII-XX 11-13. Anal III 12-13. Scales small (75-80). Differs from *Xenochromis* only in having the teeth large, few, and set well apart.

Tanganyika; a single species.

33. *ERETMODUS*, Bouleng., 1898
(type *E. cyanostictus*, Bouleng.).

Dorsal XXIII-XXV 3-5. Anal III 6-7. Scales denticulate, large (32-35); two lateral lines. Teeth rather strong, distally expanded, compressed and truncate, in 2 or 3 series. Lower pharyngeal subtriangular, with small slender teeth. Occipital crest ending behind a broad and deep depression on anterior part of skull, formed by frontals, and in front by ethmoid and lateral ethmoids; parietal crests ending above posterior part of orbits; ethmoid separated from vomer; jaws strong; præmaxillary processes stout; maxillary broadest distally. Articular surface for upper pharyngeals formed by parasphenoid in the middle and basioccipital at the sides. Vertebræ 30 (15+15); a pair of inferior

apophyses formed equally by third and fourth vertebræ; præcaudals with parapophyses from third; ribs on parapophyses.

Tanganyika; a single species.

34. SPATHODUS, Bouleng., 1900
(type *S. erythron*, Bouleng.).

Dorsal XXIII 5. Anal III 6-7. Scales denticulate, large (30-31); two lateral lines. Teeth rather strong, distally slightly expanded, compressed and rounded, uniserial. Apparently differs from *Eretmodus* only in the dentition.

Tanganyika; a single species.

35. TELMATOCHROMIS, Bouleng., 1898
(type *T. temporalis*, Bouleng.).

Dorsal XVIII-XXII 6-8. Anal V-VII 5-7. Scales rather large (40-52); nuchal scales very small; two lateral lines. A band of small tricuspid teeth and an outer series of conical teeth, the anterior strong. Skeleton as in *Eretmodus*, but no parietal crests and inferior apophyses on third vertebra only. Vertebra 33 (16 + 17).

Tanganyika; two species.

36. JULIDOCHROMIS, Bouleng. 1898
(type *J. ornatus*, Bouleng.).

Dorsal XXII-XXIV 5. Anal VIII-IX 4-6. Scales rather large (45-50); nuchal scales very small; two lateral lines. A band of small conical teeth and strong anterior canines. Skeleton as in *Telmatochromis*, but suborbitals unossified, and parietal crests distinct. Vertebrae 34 (17 + 17).

Tanganyika; a single species.

37. LAMPROLOGUS, Schilthuis, 1891
(type *L. congolensis*, Schilth.).

Dorsal XVI-XXI 6-11. Anal IV-X 4-8. Scales large or small; nuchal scales very small; two lateral lines, or the lower absent. A band of small conical teeth and anterior canines. Suborbitals ossified. Vertebrae 31-35 (14-17 + 16-19); third or fourth with inferior apophyses. Skeleton as in *Telmatochromis*, but parietal crests distinct.

Tanganyika and Congo; 27 species.

The above data enable the origin and relationships of the Cichlid fauna of Lake Tanganyika to be discussed.

Tylochromis is found in the Congo and in West Africa, and is represented in Tanganyika by a single species; it is an isolated genus, whose nearest relative is *Ptychochromis* of Madagascar. Of the large African genus *Tilapia* only the widely-distributed *T. nilotica* has reached Tanganyika, apparently through L. Kivu; the endemic *Neotilapia* has the structure of *T. nilotica* and its allies, but differs in its dentition, having all the teeth tricuspid.

A small group of endemic genera begins with *Limnotilapia*, which is nearly related to, but is in some respects more generalized than *Tilapia*, and leads on the one hand to *Lobochilotes* and on the other to *Gephyrochromis*, *Simochromis*, and *Tropheus*; in this group the *Limnotilapia* dentition (outer teeth bicuspid, inner tricuspid) undergoes various modifications; *Lobochilotes*, teeth compressed, unicuspid; *Gephyrochromis*, outer teeth conical; *Simochromis* and *Tropheus*, anterior outer teeth bicuspid, lateral conical.

Another little group of endemic genera commences with *Ophthalmotilapia*, which is closely related to *Limnotilapia*, but has all the teeth tricuspid (or sometimes unicuspid), small, and fixed. This genus has given rise to *Cyathopharynx*, distinguished by the small scales and the form of the lower pharyngeal, and to *Cunningtonia*, *Asprotilapia*, and *Petrochromis*, in which the tricuspid teeth are long, slender, and movable. It is interesting to note that the total number of dorsal rays is nearly the same in *Petrochromis* as in the other genera, but that the spines have increased at the expense of the soft rays; this genus has a species in L. Nyassa, but there can be little doubt that it originated in Tanganyika.

The endemic *Limnochromis*, with conical teeth, does not differ very essentially from *Limnotilapia* in other characters. *Cyphotilapia* has one species from Tanganyika and another from the Upper Congo; if, as seems likely, this genus is *Limnochromis* specialized, it probably originated in the lake. The monotypic *Boulengerochromis* is essentially a small-scaled *Limnotilapia*, and *Perissodus* seems to differ from it only in the peculiar dentition.

The seventeen genera mentioned above have the pharyngeal apophysis formed by the parasphenoid alone; two (*Tylochromis*, *Tilapia*) are widely distributed genera, each represented in the lake by a single species; one endemic genus (*Neotilapia*) is closely related to *Tilapia*; the rest may have originated in the lake from a single ancestral type, which *Limnotilapia*

most nearly resembles; they are peculiar to Tanganyika, except for a *Petrochromis* in Lake Nyassa and a *Cyphotilapia* in the Congo.

The remaining genera have the pharyngeal apophysis formed partly by the basioccipital; the widely distributed *Haplochromis* has two endemic species in Tanganyika; there are also a number of endemic genera with small conical teeth, closely related to *Haplochromis*; of these *Aulonocranus* leads to *Trematocara*, and *Ectodus* through *Callochromis* to *Xenotilapia* and *Grammatotria*.

A well-marked group includes genera with small scales, all endemic; of these *Hemibates*, with small conical teeth, is intermediate between *Haplochromis* and *Bathybates*, with strong pluriserial teeth, and *Haplotaxodon*, with rather small uniserial teeth. *Xenochromis* and *Plecodus* differ from *Haplotaxodon* only in their peculiar dentition. Another well-marked group apparently derived from *Haplochromis* includes the genera with strong anterior teeth; this group includes *Eretmodus* and *Spathodus*, with incisor-like teeth and three anal spines, and *Telmatochromis*, *Julidochromis*, and *Lamprologus*, with strong conical teeth and 4 to 10 anal spines. All but *Lamprologus* are peculiar to the lake, and the great diversity of the Tanganyika species of *Lamprologus* and its close relationship to the more generalized *Telmatochromis* make it almost certain that it originated in Tanganyika.

The above remarks may be summarized thus:—Nearly all the Tanganyika Cichlidæ are endemic species belonging to genera that originated in the lake; except *Neotilapia* these genera fall into two divisions, which may have evolved in the lake from two ancestral types, one nearly related to *Limnotilapia* and the other to *Haplochromis*.

IV.—*New or little-known Tipulidæ (Diptera)*.—I. *Ethiopian Species*. By CHARLES P. ALEXANDER, Ph.D., Urbana, Illinois, U.S.A.

THE new species described in the following pages will be discussed more fully and figured in a monographic treatment of the crane-flies of the Ethiopian region that the writer has in preparation.

The species described were sent to me for naming by Rev. J. A. Reis, Dr. E. Warren, and Prof. A. J. T. Janse, to all of whom I express my sincere thanks.

The holotypes are preserved in the collection of the writer, unless stated otherwise.



Regan, C. Tate. 1920. "The classification of the fishes of the family Cichlidae.--I. The Tanganyika genera." *The Annals and magazine of natural history; zoology, botany, and geology* 5, 33–53.

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