

# THE ANNALS

AND

## MAGAZINE OF NATURAL HISTORY.

[EIGHTH SERIES.]

No. 51. MARCH 1912.

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XXVIII.—*The Classification of the Teleostean Fishes of the Order Pediculati.* By C. TATE REGAN, M.A.

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### Order PEDICULATI \*.

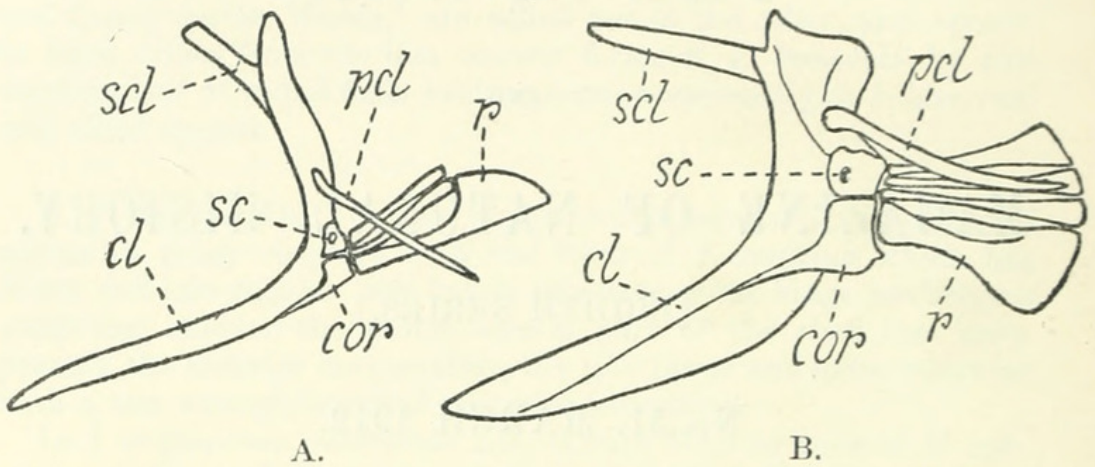
ACANTHOPTEROUS physoclists with jugular pelvic fins, each of a spine and 5 or fewer soft rays; gill-membranes broadly united to isthmus. Mouth bordered above mainly by the præmaxillaries, which are often protractile; maxillaries toothless; no supramaxillaries; suborbitals unossified; hyo-palatine and opercular bones all present, except the mesopterygoid, which is small or absent; lower pharyngeals separate. Parietals, when present, separated by supra-occipital; orbitosphenoid, basisphenoid, and opisthotic absent; first vertebra rigidly attached to skull, the neural arch suturally united to the exoccipitals. Vertebral centra co-ossified with arches; posterior præcaudal vertebræ with downwardly directed parapophyses; hypurals a pair of expanded plates, which may unite to form one only; ribs absent. Post-temporal short, simple, firmly attached or

\* Gill's recent popular illustrated memoirs on the life-histories of the Angler and of the Toad-fishes (Smithsonian Misc. Coll. xlvii. 1905, p. 500, and xlviii. 1907, p. 388) and on 'Angler Fishes; their Kinds and Ways' (Smithsonian Rep. f. 1908, p. 565) contain much of interest concerning the Pediculates.



suturally united to epiotic, pterotic, and sometimes parietal and exoccipital; supra-cleithrum more or less elongate; post-cleithrum single; hypercoracoid and hypocoracoid small;

Fig. 1.

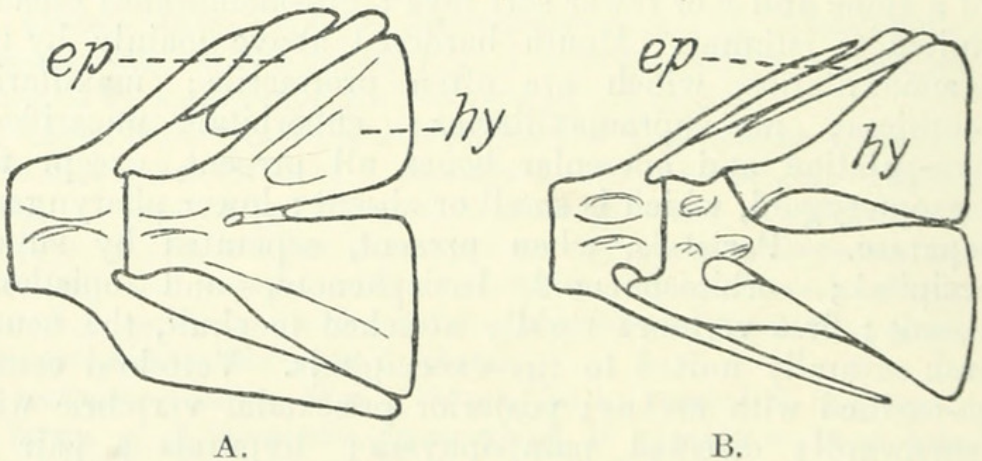


Pectoral arch (inner view) of A. *Antennarius nummifer* and B. *Batrachoides didactylus*.

cl, cleithrum; scl, supraclithrum; pcl, post-cleithrum; sc, hypercoracoid; cor, hypocoracoid; r, radial.

no mesocoracoid; pectoral radials elongate, the lowest considerably expanded distally; pelvic bones directly attached to cleithra.

Fig. 2.



Basal bones of caudal fin of A. *Antennarius nummifer* and B. *Batrachoides didactylus*.

ep, epurals (epaxial basalia); hy, hypurals.

The Batrachoidea are here included in the Pediculati rather than in the Percomorphi, for it can hardly be the

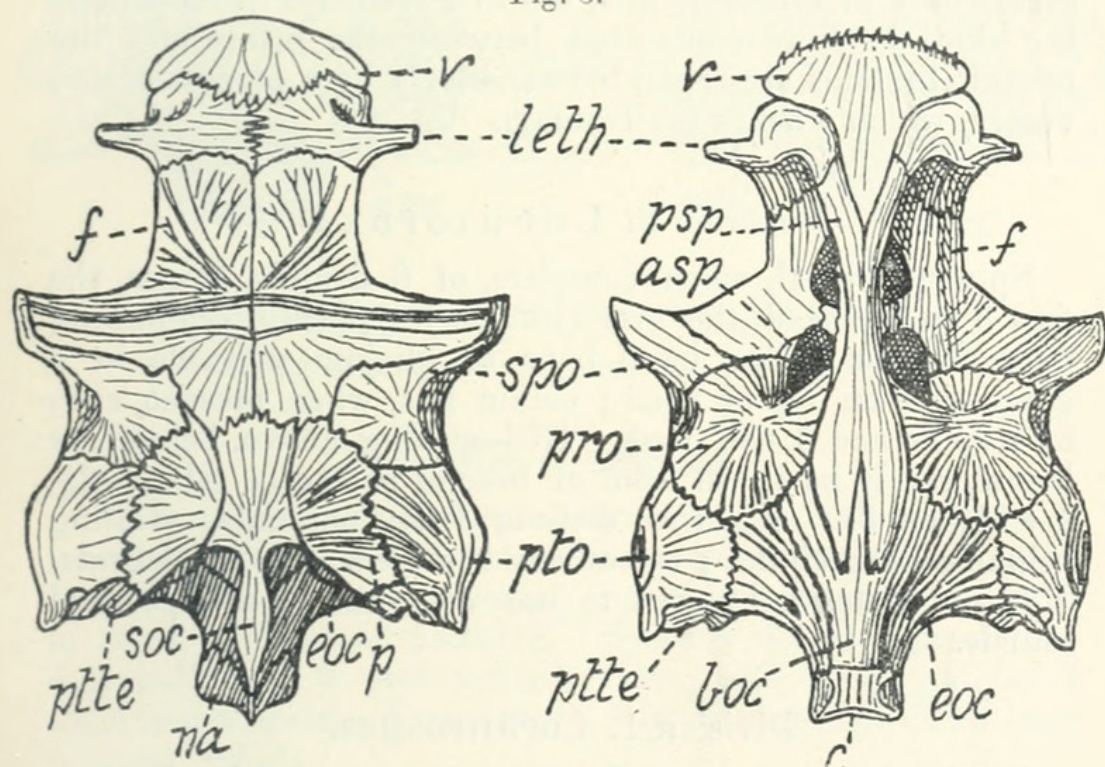


case that the resemblances in osteological characters, especially in the structure of the pectoral arch, are not due to real affinity. In many ways the Batrachoids are more generalized than the typical Pediculates, but in some respects, notably the reduction in number of the pelvic fin-rays and the ankylosis of parietal and epiotic, they are more specialized. The Pediculates might certainly be regarded as highly specialized Percoids, were it not that in the Percomorphi all the principal hypurals are attached to the last vertebra, whereas in the Batrachoids the upper hypural plate is ankylosed to the last half-centrum, and that supporting the lower half of the fin is united to the preceding centrum, much as in the Salmopercae; this seems to be a primitive character.

### Suborder 1. BATRACHOIDEA.

Spinous dorsal post-cephalic, of 2 to 4 pungent spines, with fixed basalia; each pelvic fin of a spine and 2 or 3

Fig. 3.



Skull of *Batrachoides didactylus*, from above and from below.

v, vomer; leth, lateral ethmoid; f, frontal; p, parietal; soc, supraoccipital; ex, exoccipital; boc, basioccipital; spo, sphenotic; pto, pterotic; pro, pro-otic; psp, parasphenoid; asp, alisphenoid; pte, post-temporal; na, neural arch, and e, centrum of first vertebra.

soft rays. Gill-opening in front of base of pectoral; gills 3, none on the fourth branchial arch. Epiotics absent, or anky-



losed with parietals, separated by supraoccipital; no mesethmoid. Epipleurals present, the first running from neural arch of first vertebra to cleithrum. Upper hypural ankylosed to last half-centrum, lower borne by preceding centrum. 4 or 5 pectoral radials.

### Family *Batrachoididæ*.

Body more or less elongate; head depressed; mouth wide, terminal, with conical or cardiform teeth in jaws and on palate. Soft dorsal and anal more or less elongate; pectorals broad-based. Skull depressed, flat above, more or less contracted between and expanded behind the orbits; parasphenoid and frontals united by suture between the orbits. Vertebrae 28-45 (1+9-12+17-34).

Principal genera: *Batrachoides*, *Opsanus*, *Porichthys*, *Thalassophryne*.

The cranial osteology is illustrated by the accompanying figures of the skull of *Batrachoides didactylus*; *Opsanus tau* differs only in minor details, but in *Porichthys porosissimus* the skull is more contracted between the orbits and the lateral ethmoids are separated superiorly by a process of the vomer, which reaches the frontals.

## Suborder 2. LOPHIIDEA.

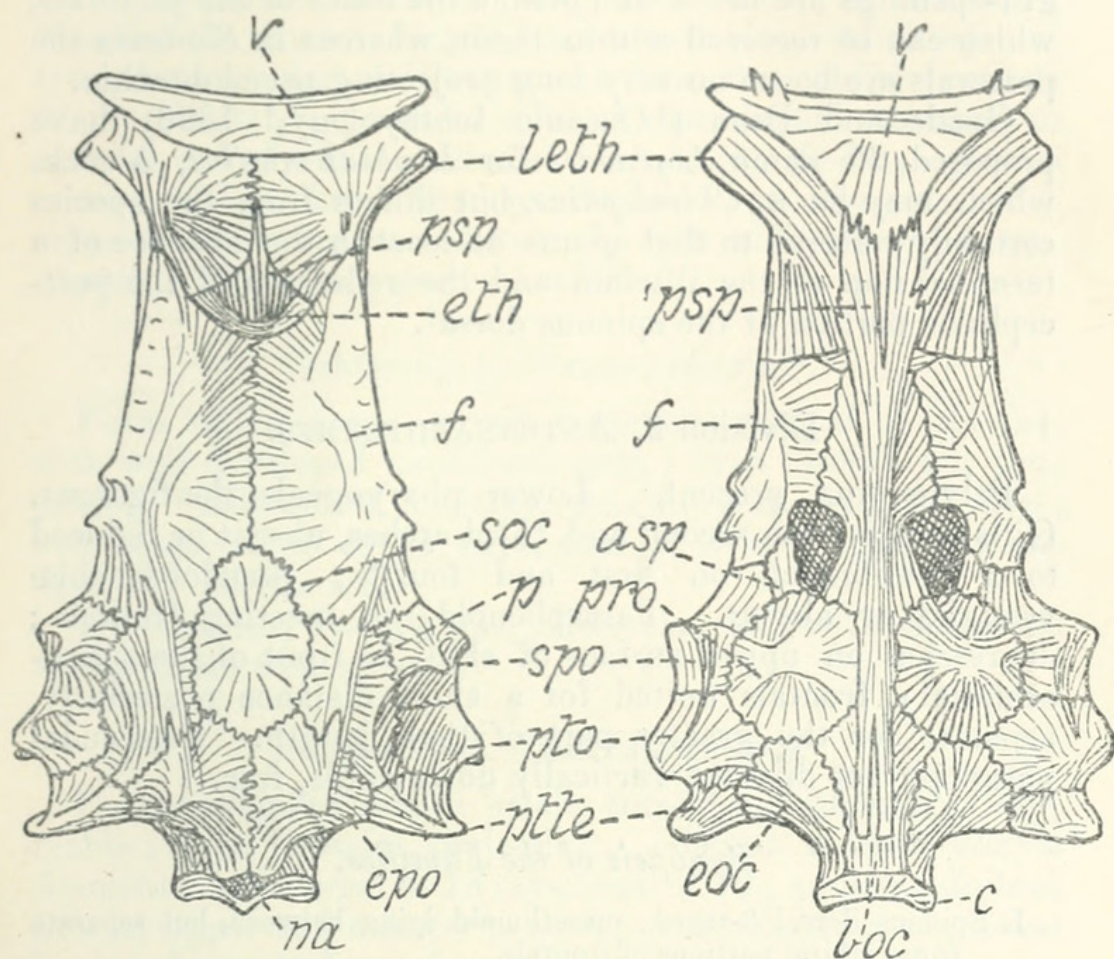
Spinous dorsal, when complete, of 6 flexible spines, the first 3 on the head, the first (*illicium*) typically terminating in a flap or bulb; basal bone of illicium movable in a depression on top of head; pelvic fins, when present, each of a spine and 5 soft rays. Gill-opening above, behind, or below, rarely partly in front of base of pectoral; gills 2,  $2\frac{1}{2}$ ,  $\frac{1}{2} + 2\frac{1}{2}$ , or 3. Epiotics distinct from parietals, meeting behind supraoccipital; mesethmoid ossified. No epipleurals. Hypural plates ankylosed to last vertebra. 2 or 3 pectoral radials.

### Division 1. LOPHIIFORMES.

Pelvic fins present. Lower pharyngeals dentigerous. Gills 3, complete on first, wanting on fourth branchial arch; pseudobranchiæ. Parasphenoid united by suture to frontals between the orbits; frontals in contact for the greater part of their length; upper surface of skull with a depression in front of the supraoccipital. Præcaudal parapophyses directed downwards and obliquely backwards, overlapping and closely attached to each other.



Fig. 4.

Skull of *Lophius piscatorius*, from above and from below.

Lettering as in fig. 3. *eth*, mesethmoid; *epo*, epiotic.

### Family 1. Lophiidae.

Body naked; head large, depressed; mouth wide, protractile, with depressible cardiform teeth in jaws; palate usually toothed. Gill-opening below and behind, or partly in front of base of pectoral. Spinous dorsal typically of 3 cephalic and 3 post-cephalic rays; soft dorsal and anal short or moderate. Vertebrae 19\* to 32 or more. Two long pectoral radials.

The Lophiidae are shore-fishes, or may live on the bottom in deep water. There are 4 well-defined genera, viz.: *Lophius*, Linn., *Lophiomus*, Gill, *Sladenia*, Regan, and *Chirolophius*, Regan. The last is distinguished by the free opercular flap and the long projecting pseudobranchia. In

\* In "*Lophius*" *brachysomus*, Agass., from the Upper Eocene of Monte Bolca, there are about 19 vertebrae, as in *Lophiomus* and *Chirolophius*.



*Lophius* (27 to 32 vertebræ) and *Lophiomus* (19 vertebræ) the gill-openings are below and behind the bases of the pectorals, which can be received within them, whereas in *Sladenia* the pectorals are borne on very long projecting pseudobrachia.

Goode and Bean ('Oceanic Ichthyology,' 1896) have proposed the name *Lophiodes* for *Lophius mutilus*, Alcock, which may be a *Chirolophius*, but differs from the species certainly referred to that genus at least in the absence of a terminal flap to the illicium and the reduction of the post-cephalic portion of the spinous dorsal.

## Division 2. ANTENNARIIFORMES.

Pelvic fins present. Lower pharyngeals dentigerous. Gills complete on second and third arches, absent or reduced to a hemibranch on first and fourth; pseudobranchiæ vestigial or absent. Parasphenoid not meeting frontals; depression on upper surface of skull in front of the supra-occipital; frontals united for a short distance posteriorly, separate for the greater part of their length. Præcaudal parapophyses directed vertically downwards, free.

### *Synopsis of the Families.*

- I. Spinous dorsal 3-rayed; mesethmoid lying between, but separate from, orbital portions of frontals.

- Rays of spinous dorsal separate, or connected at the base only; gill-opening below base of pectoral; 3 pectoral radials ..... 1. *Antennariidæ*.  
 Second and third rays of spinous dorsal fully connected; gill-opening behind base of pectoral; 2 pectoral radials ..... 2. *Brachionichthyidæ*.

- II. Spinous dorsal represented by the illicium only.

- Mesethmoid in front of orbital portions of frontals; gill-opening behind pectoral; mouth very oblique; illicium supra-rostral; 3 pectoral radials ..... 3. *Chaunacidæ*.  
 Mesethmoid between orbital portions of frontals; gill-opening above pectoral; mouth horizontal; illicium in a cavity at anterior end of snout; 2 pectoral radials ..... 4. *Onchocephalidæ*.

### Family 1. *Antennariidæ*.

Naked or spinulose, compressed; mouth protractile; teeth in jaws and on palate; gills  $\frac{1}{2} + 2\frac{1}{2}$ ; gill-opening small, immediately below base of pectoral. Spinous dorsal



of 3 cephalic rays, separate or connected at the base; soft dorsal moderate or rather long, anal short or moderate. Mesethmoid narrow, forming a vertical interorbital septum, lying between but well separated from the orbital portions of the frontals; posterior end of mesethmoid attached to anterior end of united portion of frontals (fig. 5, B); opercles narrow. Vertebrae 19; præcaudals not elongate, with separate neural spines and from the fifth with strong parapophyses. Three long pectoral radials.

Subfamily 1. *ANTENNARIINÆ* \*.

Form rather deep; mouth moderate, vertical or oblique, with well-developed cardiform teeth; eyes lateral, not projecting. Illicium of moderate length, with terminal flap; soft dorsal of 10 to 15 rays, anal of 6 to 9; pectoral undivided; pelvics free.

*Antennarius*, *Pterophryne*, *Saccarius*, &c., with numerous species from tropical seas.

Subfamily 2. *TETRABRACHIINÆ*.

Form elongate; mouth small, transverse, superior; teeth feeble; eyes superior, projecting. Illicium a small simple filament; soft dorsal of 18 rays, anal of 12; pectoral divided into an upper and a lower portion; pelvic broadly connected by membrane to base of pectoral.

A single species, *Tetrabrachium ocellatum*, Günth., from New Guinea.

Family 2. *Brachionichthyidæ*.

*Brachionichthys*, with a few species from Southern Australia, differs externally from the *Antennariinæ* in the more elongate form, the second and third rays of the spinous dorsal fully connected by membrane, the longer soft dorsal (15 to 20 rays), and the higher and more posterior gill-openings, behind the pectorals. The skeleton has been figured by Cuvier (Mém. Mus. Paris, iii. 1817, pl. 18) and is similar to that of *Antennarius*, except that there are 23 vertebrae and only 2 pectoral radials.

Family 3. *Chaunacidæ*.

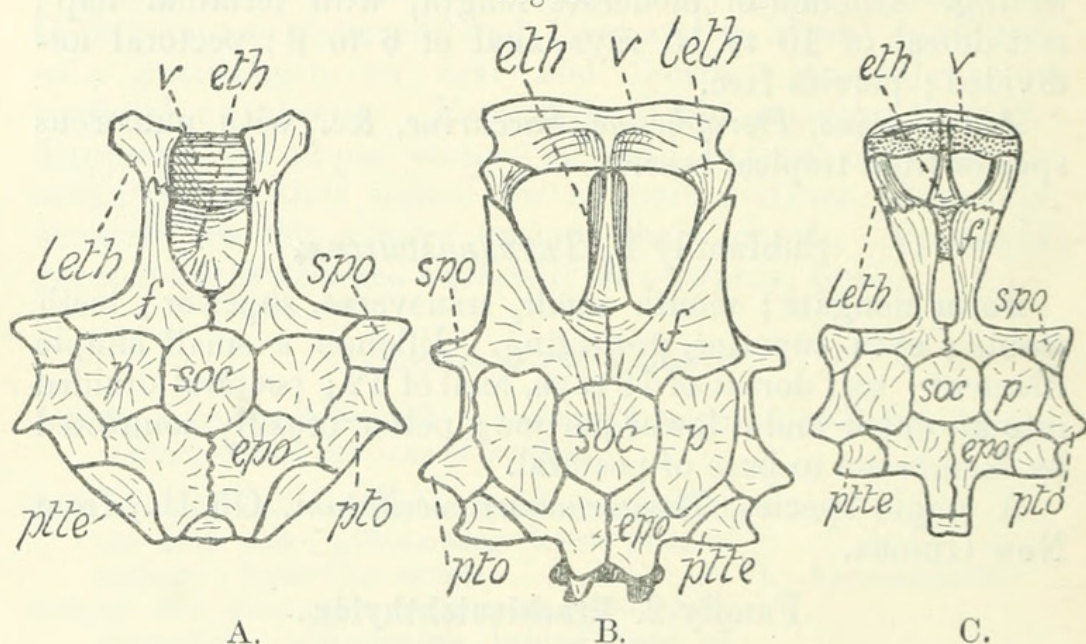
*Chaunax*, with a few species from rather deep water, differs from the *Antennariidæ* in many important characters;

\* *Histionotophorus bassani*, Zigno, from the Upper Eocene of Monte Bolca, probably belongs to this subfamily (cf. Eastman, Bull. Mus. Comp. Zool. xlv. 1904, p. 32, and Gill, 'Science,' (2) xx. p. 845).



the head is as broad as deep; the spinous dorsal is represented only by the illicium, which is short, with a large terminal transverse expansion, the whole folding back in a naked area on the upper surface of the snout, the rest of the fish being spinulose; there is no gill on the first arch; the gill-openings are above and behind the base of the pectorals. Garman's figure (Mem. Mus. Comp. Zool. xxiv. 1899, pl. xvi.) shows that the vertebral column and pectoral arch are Antennariid, but the opercles are notably broader. I have ascertained that the interorbital portions of the frontals are longer and less widely separated than in *Antennarius*, and that the mesethmoid lies in front of instead of between them (fig. 5, C).

Fig. 5.



Skulls of A. *Halieutea stellata*, B. *Antennarius nummifer*, and C. *Chaunax pictus*, seen from above (somewhat diagrammatic).

Lettering as in preceding figures.

#### Family 4. Onchocephalidæ.

Body spinate; mouth small or moderate, horizontal, terminal or subterminal, protractile downwards; villiform teeth in jaws and sometimes on palate; gills 2 or  $2\frac{1}{2}$ , no gill on the first arch; gill-opening small, above base of pectoral. Spinous dorsal represented by the illicium, which has a very short stalk and broad transverse expansion, the whole contained in a cavity on anterior surface of snout; soft dorsal and anal short, few-rayed, posterior. Mesethmoid ossified as an interorbital septum, but broadening out above



and filling the interspace between the frontals (fig. 5, A); opercles very broad. Vertebrae 19; third to sixth elongate; præcaudals with neural arches laminar, rigidly united, posteriorly (from the seventh) with rather feeble parapophyses. Two long pectoral radials.

Principal genera: *Onchocephalus* (Malthe), *Halieutea*, *Halieutichthys*, *Dibranchus*, *Malthopsis*, *Halicmetus*, *Cœlophrys*.

Garman has figured the skeleton of *Malthopsis* (Mem. Mus. Comp. Zool. xxiv. 1899, pl. xxvi.).

In the typical genera the tail is well-marked off from a strongly depressed circular, ovate, cordate or triangular disc; in *Halieutella* (which may be a young *Halieutichthys*) the disc is subspherical; in *Cœlophrys* the form is oblong, as broad as deep, the trunk gradually passing into the tail.

Like the *Lophiidae*, these are shore-fishes or live on the bottom in deep water.

### Division 3. CERATIIFORMES.

Pelvic fins absent. Lower pharyngeals reduced, toothless. Gills complete on second and third arches, absent or reduced to a hemibranch on first and fourth; no pseudobranchiæ. Parasphenoid not meeting frontals; a trough or groove on upper surface of skull, its floor wholly or mainly formed by supraoccipital. Præcaudal parapophyses directed vertically downwards, free. Pectoral radials comparatively short.

These are fishes of the open sea, swimming at various depths, uniform in colour, and with the illicium often terminating in a luminous bulb.

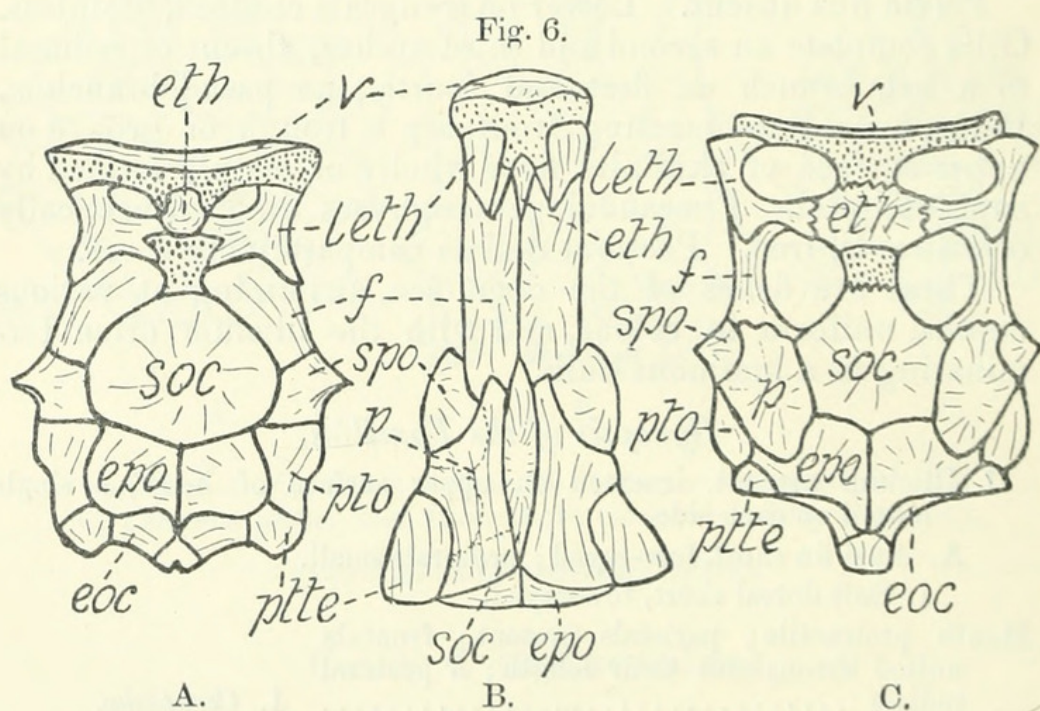
#### *Synopsis of the Families.*

- I. Illicium present, inserted on upper surface of head; a single nostril on each side.
  - A. Anal fin short, few-rayed; pectorals small.
    1. Soft dorsal short, few-rayed.
 

Mouth protractile; parietals present; frontals united throughout their length; 3 pectoral radials .....	1. <i>Ceratiidae</i> .
Mouth not protractile; parietals absent; frontals separated by the supraoccipital; 2 pectoral radials .....	2. <i>Himantolophidae</i> .
    2. Soft dorsal longer, of 12 to 15 rays; mouth not protractile; parietals present; frontals separated by the supraoccipital; 3 pectoral radials ..... 3. *Melanocetidae*.
  - B. Anal and soft dorsal moderately long, of 11 to 17 rays; pectorals large ..... 4. *Caulophrynidae*.
- II. Illicium inserted at end of snout ..... 5. *Gigantactinidae*.
- III. Illicium absent; two nostrils on each side. 6. *Aceratiidae*.



It will be seen that I am able to give osteological characters for only 3 of the 6 families, but these are exceptionally well defined. Lütken has given valuable descriptions, accompanied by excellent figures, of the osteology of *Ceratias* and *Himantolophus* (Dan. Vidensk. Selsk. Skr. (5) xi. 1878, pp. 307-348, c. figg., and (6) iv. 1887, pp. 323-334, c. pl.). Garman's figure of the skeleton of *Dolopichthys* (Mem. Mus. Comp. Zool. xxiv. pl. xiv.) does not reveal any essential differences from *Himantolophus*. As most of the species of this group in the British Museum collection are represented by unique types, a thorough osteological study was out of the question; on the other hand, the skin of these fishes is so loose, that once an incision has been made (which has generally been done to ascertain the branchial formula) it is a very simple matter to examine the bones of the upper surface of the head. Thus I have been able to ascertain that *Diceratias* shows many important resemblances to *Himantolophus*, but *Melanocetus* differs in the presence of well-developed parietals.



Skulls of A. *Diceratias bispinosus*, B. *Ceratias holbolli*, and C. *Melanocetus johnsonii*, seen from above (somewhat diagrammatic). B is based on Lütken's figure.

Lettering as before.

### Family 1. Ceratiidæ.

Strongly compressed; eyes small; gill-openings below and immediately behind pectorals; gills  $2\frac{1}{2}$ . Mouth pro-



tractile, oblique or subvertical, moderately wide; teeth in jaws acicular, depressible; palate toothless. Spinous dorsal represented by a long slender illicium with terminal bulb inserted on the upper surface of the head, and by a second post-cephalic spine, sometimes replaced by 2 or 3 caruncles; soft dorsal and anal short, posterior, each of 3 or 4 rays; pectorals small.

Præmaxillary pedicels moderately long; maxillaries expanded and truncated distally. Skull long and narrow; frontals meeting throughout their length; supraoccipital narrow, forming the floor of a groove which is bounded laterally by the large parietals (fig. 6, B); epiotics not prominent on upper surface of skull; opercles narrow. Three pectoral radials. Vertebræ 20 (11+9).

Genera: *Ceratias*, *Mancalias*, *Cryptosparas*.

## Family 2. *Himantolophidæ*.

Mouth not protractile, vertical, oblique or horizontal, wide or moderately wide; teeth in jaws acicular, depressible; vomer sometimes toothed. Gills  $2\frac{1}{2}$  or  $\frac{1}{2} + 2\frac{1}{2}$ , the first arch with or without a hemibranch. Spinous dorsal a supra-rostral illicium with terminal bulb, sometimes followed by a second ray; soft dorsal and anal posterior, short, few-rayed; pectorals small. Præmaxillary pedicels short; maxillaries slender; opercles narrow; skull with a large trough superiorly, the floor formed mainly by the large supra-occipital, which extends forward to the ethmoid region, the margins formed by the frontal ridges, which end posteriorly in a pair of prominent spines borne by the sphenotics (fig. 6, A); frontals completely separated; parietals absent (or ankylosed with the sphenotics). Two pectoral radials. Vertebræ 19 (10+9).

### *Synopsis of the Genera.*

#### I. Spinous dorsal of two rays.

- |   |  |
|---|--|
| Second ray of spinous dorsal above pectorals .....              | <i>Oneirodes</i> , Lütken, 1871.   |
| Second ray of spinous dorsal immediately behind the first ..... | <i>Diceratias</i> , Günth., 1887 (incl. <i>Paroneirodes</i> , Alcock, 1890). |

#### II. Spinous dorsal of a single ray.

##### A. A long hyoid barbel, bifid distally.

*Linophryne*, Coll., 1886.



## B. No barbel.

1. Skin without scutes . . . . . *Dolopichthys*, Garm., 1899.
2. Skin with large spinate scutes.

Form compressed . . . . . *Himantolophus*, Reinh., 1837.  
 Form depressed . . . . . *Aegeonichthys*, Clarke, 1878\*.

Family 3. *Melanocetidæ*.

Mouth not protractile, vertical, wide; teeth in jaws acicular, depressible; vomer sometimes toothed. Gills  $2\frac{1}{2}$ . Spinous dorsal represented by a supra-rostral illicium with terminal bulb; soft dorsal posterior, moderately long, of 12 to 15 rays; anal short, 4-rayed; pectorals small. Præmaxillary pedicels short; maxillaries slender; skull short and broad, with a large trough superiorly, the floor mainly formed by the large supraoccipital, which extends forward to the ethmoid region; frontals completely separated (fig. 6, C); sphenotic not bearing a spine; opercles narrow. Three pectoral radials.

Genera: *Melanocetus*, *Liocetus*.

Family 4. *Caulophrynidæ*.

Mouth not protractile, wide, moderately oblique; teeth acicular, in jaws and on palate. Gills  $\frac{1}{2} + 2\frac{1}{2}$ . Illicium slender, with terminal bulb, inserted on upper surface of head; soft dorsal and anal rather long, of 11 to 16 rays, which are considerably produced; pectorals large and broad-based.

This family includes a single genus, *Caulophryne*, with 2 species, *C. jordani*, Goode & Bean, and *C. pelagicus*, Brauer. Probably the opercles are broader and the pectoral radials longer than in other Ceratiiformes.

Family 5. *Gigantactinidæ*.

*Gigantactis vanhoeffeni*, Brauer, 1902, differs from the Ceratiidæ and Himantolophidæ in the insertion of the illicium at the extremity of the snout.

Family 6. *Aceratiidæ*.

Mouth terminal, horizontal; 3 rostral denticles (? præmaxillary teeth) above middle of upper jaw; eyes directed forward; 2 nostrils on each side. Illicium absent; soft dorsal and anal very small, 2- or 3-rayed.

\* This genus may not be distinct from *Himantolophus*, as a fish said to be specifically identical with *H. reinhardtii* has recently been described and figured as broader than deep (Williamson, Rep. Fishery Board for Scotland, 1909 (1911), pt. 3, p. 51).



The 3 species described by Dr. Brauer ('Valdivia' Tief-seefische, p. 323, 1906) may be referred to 2 genera: *Aceratias* (*macrorhinus*, *indicus*), with fixed teeth and with a large nasal papilla bearing a small anterior and large posterior nostril; and *Haplophryne*, gen. nov. (*mollis*), with depressible teeth and without nasal papilla.

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XXIX.—*New Species of Heterocera from Costa Rica.*—XIV.  
By W. SCHAUS, F.Z.S.

Pyralidæ.

Subfamily PYRAUSTINÆ.

*Neurophyseta turrialbalis*, sp. n.

♀. Palpi and head white. Collar and thorax white, shaded with dark yellow. Abdomen: basal segment whitish, with round, subdorsal, fuscous-brown spots; other segments orange, with paler transverse shades and a dark segmental line on third segment. Fore wings deep orange; a basal spot and origin of lines on costa fuscous; a darker subbasal shade, marked by fuscous-brown spots in cell and below cell, and followed by a yellowish-white shade; antemedial and medial orange-brown lines, oblique on costa, angled on subcostal, the former straight, the latter inbent below vein 2, straight below submedian, the space between the lines whitish above and below submedian; an inbent crescent on discocellular, whitish, faintly edged with dark irroration; postmedial remote, fine, dark, geminate, divided by a whitish line, outcurved from costa, obsolescent below 4, and preceded by a small whitish shade between 5 and 7; a marginal black streak from apex to vein 3. Hind wings white; an antemedial and a postmedial orange line; the termen shaded with orange, suffusing with an indistinct subterminal orange line.

Expanse 17 mm.

*Hab.* Turrialba, 5000 feet.

*Scybalista sanctalis*, sp. n.

♀. Palpi white, laterally shaded with grey. Body above dark grey; white segmental lines on abdomen; underneath whitish. Fore wings brownish grey; base slightly darker,





Regan, C. Tate. 1912. "The classification of the teleostean fishes of the order Pediculati." *The Annals and magazine of natural history; zoology, botany, and geology* 9, 277–289.

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