

## ON THE CLASSIFICATION OF THE MAIL-CHEEKED FISHES.

BY THEODORE GILL.

In the northern seas are found fishes known as Sculpins, Pogges, and Gurnards. In the *Systema Naturæ*, Linnæus referred the Sculpins and Pogges to the genus (160) *Cottus*, whose essential character was a head broader than the body, while the Gurnards were segregated in the genus (172) *Trigla*, distinguished by free finger-like rays below the pectorals. In the Mediterranean and warmer seas live compressed scaly fishes more or less beset with tag-like cutaneous appendages; these were combined in the genus (61) *Scorpena*, whose chief characteristic was a head with scattered cirri or tags (*caput scirrhis adpersum*.) In the northern seas is also found a species now known to be related to the *Scorpena*, but which was referred by Linnæus to the genus *Perca* as *P. marina*. Such fishes are the subjects for present inquiry.

## CUVIER.

In 1829, in the *Règne Animal* and the *Histoire Naturelle des Poissons*, Cuvier established, as the second family of Acanthopterygian fishes,\* those with mailed cheeks, "Jones cuirassées." This family was intended to embrace a number of fishes to which the singular shape of the head, beset with spines and armed and cuirassed, gives a peculiar physiognomy which has always caused them to be classified in special genera, although they have intimate relations with the perches. Their common character is to have suborbitals more or less extended over the cheek and articulating behind with the preoperculum. *Uranoscopus* alone, according to Cuvier (which he referred to the family of perches), has something approximating it, but its suborbital, although very large, is attached behind to the temporal (prootic) bone, and not to the preoperculum. To the family thus defined he referred the genera *Trigla*, *Cottus*, and *Scorpena* of Linnæus, as well as some of the Linnæan *Gasterosteï*.†

\* Cuvier gave no Latin name to the "Jones cuirassées," and the defect has been attempted to be remedied by the proposal of various terms involving the idea, *e. g.*, *Buccæ loricatæ* (McMurtrie, 1831), *Loricati* (Jenyns, 1835), *Parcioplondæ* and *Parcioplitæ* (Richardson, 1836), *Canthioplex* (Swainson, 1838), *Cataphracti* (Müller, 1843), *Scleroparci* (Gravenhorst, 1845), *Sclerogenidæ* (Owen, 1846), and *Cataphractoidæ* (Cantor), 1850.

† La deuxième famille des Acanthoptérygiens, celle des JONES CUIRASSÉES, contient une nombreuse suite de poissons auxquels l'aspect singulier de leur tête, diversement hérissée et cuirassée, donne une physionomie propre qui les a toujours fait classer dans des genres spéciaux, bien qu'ils aient de grands rapports avec les perches. Leur caractère commun est d'avoir les sous-orbitaires plus ou moins étendus sur la joue, et s'articulant en arrière avec le préopercule. L'*Uranoscope* seul, dans la famille précédente, a quelque chose d'approchant; mais son sous-orbitaire, bien que très large, s'attache en arrière aux os de la tempe, et non pas au préopercule.

Linnæus en faisait trois genres: les *Trigles*, les *Cottes*, les *Scorpenes*; mais on a dû les subdiviser, et il faut y joindre une partie de ses *Gasterostées*.

The Linnæan genera, subdivided, and additional genera subsequently discovered, follow :

*Joues cuirassées.*

Trigles.	
Trigles proprement dits.	Trigla..... } }
Prionotes.	Prionotus..... } §
Malarmats.	Peristedion..... } }
Dactyloptères.	Dactylopterus..... } §
Cephalacanthes.	Cephalacanthus..... } §
Cottus.	
Cottus proprement dits.	Cottus..... } }
Aspidophores.	Hemitripterus..... } §
Aspidophoroides.	Bembras..... } }
Hemitriptères.	Aspidophorus..... } §
Hemilepidotes.	Platycephalus..... } }
Platycephales.	Hemilepidotus..... } §
Scorpènes.	Blepsias..... } }
Scorpènes proprement dites.	Apistes..... } §
Tannianotes.	Scorpena..... } }
Sebastes.	Sebastes..... } §
Pterois.	Pterois..... } §
Blepsias.	Agriopus..... } §
Apistes.	
Agriopes.	
Pelors.	
Synancées.	Pelor..... } §
	Synanceia..... } §
Lepisacanthes.	
Epinoches.	
Epinoches proprement dites.	Monoëcentris.
Gastrés.	Gasterosteus.
Oreosomes.	
	Oreosoma.

In the first column, reproduced from the *Régne Animal* (v. 2, pp. 158-171, and table méthodique), the intention was apparently to correlate the genera and subgenera with the genera established by Linnæus and to intercalate the subsequently discovered genera in place.

In the second column (in which, for present use, the Latin instead of the French terms are given) the sequence of the "*Histoire Naturelle des Poissons*" (v. 4, pp. 7, 8, *et seq.*) is shown.

The family thus defined was almost universally adopted from the time of its proposal until 1858, or at least, by the few who disintegrated it, the constituent families were kept closely approximated.

KAUP.

In 1858, Dr. J. J. Kaup, published observations on the mail-cheeked fishes,\* for which he used the name "*TRIGLIDÆ*," introducing some

\* Einiges über die *Acanthoptérygiens à joue cuirassée*, Cuv., Von Kaup." <Archiv für Naturgeschichte, 24. Jg. 1858, I, 329-343.

startling innovations. He proposed to remove from the family *Platycephalus*, *Bembras*, and *Hoplichthys*, and subdivided the family as follows:

## II. Family TRIGLIDÆ.

### 1. Subfamily *Choridactylinae*.

1. *Choridactylus*. 2. *Polemias*.\* 3. *Miuons*. 4. *Apistus*. 5. *Cocotropus*.†

### 2. Subfamily *Scorpeninae*.

1. *Pelor*. 2. *Pterois*. 3. *Oreosoma*. 4. *Scorpena*. 5. *Synanceia*.

### 3. Subfamily *Triglinae*.

1. *Cephalacanthus*. 2. *Dactylopterus*. 3. *Peristethus*.‡ 4. *Prionotus*. 5. *Trigla*.

### 4. Subfamily *Cottinae*.

1. *Trichoplenra*.§ 2. *Cottus*. 3. *Agonus*. 4. *Hoplocottus*.|| 5. *Aploactis*.

### 5. Subfamily *Agriopodinae*.

1. *Trichodon*. 2. *Blepsias*. 3. *Gasterosteus*. 4. *Tenianotus*. 5. *Agriopus*.

Inasmuch as some of the names proposed in this and a subsequent article, in which the same fishes were considered from a similar point of view, are retained, it may be well to give Kaup's views and method of treatment. It will therefrom appear that there is nothing in common between his groups and those now adopted except the names and the typical constituents. The contributions of Dr. Kaup to ichthyology are indeed among the curiosities of scientific literature, and serious discussion of his views is unnecessary, if not impossible.

Before taking up this already numerous family, it is necessary to remove certain genera from it. Among these particularly is *Monocentris*, which represents the bony fish among the *Scomberidae*, as does *Peristethus* among the *Triglide*, or *Agonus* among the *Cottinae*. *Hoplostethus* also does not belong here, but among the *Holocentrinae*. This subfamily is thus arranged:

HOLOCENTRINÆ. 1. *Holocentrum*; 2. *Trachichthys*;¶ 3. *Rhynchichthys*; 4. *Beryx*; 5. *Myripristis*. *Holocentrum* is closely allied to *Rhynchichthys* and *Myripristis*, and *Trachichthys* with *Beryx*.

*Monocentris* differs principally by three soft ventral rays, which are reduced in number and length at the expense of the enormous ventral spine.

Cuvier and Valenciennes concede that *Hoplostethus* belongs to the *Holocentrinae*, since they pronounce this genus as identical with *Trachichthys*.

Dr. Schlegel has from the examination of better preserved specimens rightly separated *Hoplichthys* and brought it into the subfamily *Callionyminae*. Besides this, not only *Platycephalus*, but also *Bembras*, must be separated from this family, the first to be added to the *Acanth. abdominalis* Cuv. and the last to the *Percoidi* Cuv.

However much we may coincide in the general praise of Cuvier and Valenciennes' excellent work, as to that which concerns the critical arrangement of materials at hand, clear definition of genera, and highly accurate descriptions, which we do with pleasure and sincerity, we do not equally admire the systematic classification. In this only a beginning is made, while the authors have been satisfied to place together in separate chapters the cognate forms. There are, therefore, in this work excellent materials towards a natural system, only they are put together without guiding principles, and thus the principal reproach against the work is that the authors have

\* *Pterichthys* Sw., 2, 265.

† *Corythobatus* Cant. † *Peristedion* Lac.

§ *Sthenopops* R.

|| *Podabrus*, *Trachydermis*, etc.

¶ That *Trachichthys* represents the *Earfish*; that is, in its subfamily, the bird-type, it is only necessary to read what Cuvier (p. 478) says of the ear of this genus. (Kaup.)

not sufficiently cleared themselves of the slough of earlier systematists, and have unluckily held them of too great account.

Of the idea that in all orders, families, etc., certain typical forms appear, there is in the whole work no trace, although there are genera enough which prove this idea most clearly.

We thus see in this family, which for brevity we will call *Triglidae*, the greatest possible development of the pectorals, with which some species raise themselves above the water and move for a few moments in the air in order to escape the pursuit of their enemies.

In such elongated and winged forms as *Polemius* (*Apistus alatus*), *Pterois*, and *Dactyloptera*, all the rays are single, and this characteristic is also found in *Blepsias* and *Cottus*; among the last there are species which have all the pectoral rays single, while a few species only have isolated branched rays.

Among these generally long-winged forms the bird-type is foreshadowed, and I give them in their family, as in the class of birds, the second rank. The free finger-like, jointed rays, from 1 to 3 in number, and only serving for propulsion, which are seen in *Choridactylus*, *Polemius*, *Minous*, *Pelor*, *Peristethus*, *Prionotus*, and *Trigla*, placed in advance of the pectoral, appear to me to have some analogy with the 1 or 2 free fingers of the *Chiroptera*, which also serve as a means of propulsion on the earth. In one genus, too, *Gasterosteus*, which builds a nest, and where the male protects the eggs, I see a near analogy to the birds.

The teeth in no one genus are much developed, for they are mostly fine card-like ones in the jaws, and not often found in the vomerine or palatine bones, whence they are devourers generally of crustaceans, roe, or insects, and among them no (properly speaking) predaceous fish is found. All are true breast-finned fishes, and among a few only is the ventral somewhat behind the origin of the pectoral.

Although the ventral is always present, it is in most cases but little developed as compared with the pectoral. We find the same to be the case among the *Chiroptera*, the true Birds (*Fissirostres*), and the *Pterodactylidae* of the *Amphibians*, where the wings are likewise developed at the expense of the feet.

The bony fish constitutes another fundamental type, which is shown externally by its covering. As the bony system forms the third division among the anatomical systems and their representatives, the Amphibia take the same rank. I give to the genera *Orcosoma*, *Peristethus*, *Agonus*, and *Gasterosteus* in their subfamilies as the representatives of the *Ossaceous* fishes, the third position. The more predaceous forms, with maxillary teeth and medium-sized pectoral, I place as the fishes proper, in the fourth rank.

To the smallest forms, most often with large, abruptly falling head or large eyes, I give as the nervous type the first, and to the naked species, or such as are covered with numerous mucous pores (as in the last division of the genus *Trigla*), the last rank. It requires but little penetration to perceive that *Cocotropus* stands lower than *Choridactylus*, *Synanceia* lower than *Pelor*, *Trigla* (*lineata*, *euculus*) lower than *Cephalacanthus*, and *Aploactis* lower than *Trichopleura*, so clear is it to the apprehension.

I have thus given to the *Triglidae* the second rank in the second order of fishes, just as the swallows (*Fissirostres*) and the *Chiroptera* hold the second rank in theirs, and to the separate subfamilies and genera their corresponding position. In this way only has the following table been formed. I will not venture to assert that it is perfectly faultless, but it will probably prove itself in the main correct.

After this summary, given in a translation of Dr. Kaup's own words, it is unnecessary to contravene his postulates and assumptions. They were subsequently dissipated by himself in an article\* in which he

\* Ueber die Familie Triglidae nebst einigen Wertes über die Classification. Von J. J. Kaup, <Archiv f. Naturg., 1873, I, pp. 71-94.

proposed an entirely different classification of an artificial group which he called the suborder TRIGLOIDÆ, and from which he excluded many of the closest relations of the fishes combined under that name. His modified views are expressed in the following scheme:\*

II. Ordo STERNICHTHYES.

II. Subordo. TRIGLOIDÆ. Acanthoptérygiens à joue cuirassée, Cuv. (part.)†

- |  |  |   |
|--|--|---|
| <p>1. Hauptfamilie:<br/>Berycidae.<br/><i>Holocentrinae</i>.(1)<br/><i>Hoplostethinae</i>.(1)<br/><i>Monocentrinae</i>.(1)<br/><i>Polymixinae</i>.(2)<br/><i>Berycinae</i>.(1)</p> | <p>2. Hauptfamilie:<br/>Triglidae [p. 84].<br/>1. Cephalacanthinae.<br/>2. <i>Dactylopterinae</i>.<br/>3. Peristethinae.<br/>4. Prionotinae.<br/>5. Triglinae.</p> | <p>3. Hauptfamilie:<br/>Platycephalidae.<br/>1.<br/>2. Bembrasinae.<br/>3. <i>Hoplichthyinae</i>.<br/>4. Platycephalinae.<br/>5. Hemerocætinæ.(3)</p> |
| <p>4. Hauptfamilie:<br/>Scorpenidae.<br/>1. Sebastinae.<br/>2. Pteroinae.<br/>3. Oreosominae [<i>sic!</i> 4].<br/>4. <i>Scorpeninae</i>.<br/>5. Synanceinae.</p>                   | <p>5. Hauptfamilie:<br/>Agriopodidae.<br/>1.<br/>2. Apistinae.<br/>3. Oreosominae [<i>sic!</i> 4].<br/>4. Trichodontinae.(5)<br/>5. Agriopodinae.(6)</p>           |   |

The subfamilies indicated by the figure (1) have no relation to the mail-cheeked fishes, but belong to the superfamily *Berycoidea*; the *Polymixinae* (2) are peculiar fishes representing a distinct family; the Hemerocætinæ (3) belong to another alien, distinct family; the Oreosominae (4) appear to be related to the Zenidæ; the *Trichodontinae* (5) form the family *Trichodontidae*, and the *Agriopodinae* (6) the family *Congiopodidae*, both remote from the mail-cheeked fishes. The treatment of the rest may be compared with that in the present article.

BLEEKER.

In 1859, Dr. Pieter von Bleeker published the outlines of a new classification of fishes,‡ in which he disintegrated and widely scattered the mail-cheeked fishes, as follows:

- Caterva 1. Katapieseocephali.  
Ordo 24. Percæ. (Subordo 4. Percichthyini. Sectio 1. Parastemiptori. Tribus 4. Trachyranichthyini.)

\* Kaup, o. c., p. 79.

† The Cottids and Agonids, as well as a number of other genera of typical mail-cheeked fishes, have been excluded from the "suborder" by Dr. Kaup. "Aus der Unterordnung Trigloidae habe ich die Heterolepidina als nicht hierher gehörig entfernt. Ebenso die Genera Enneopterygius Rüpp., Aploaetis Schleg., Trichopleura Kp., Hemitripterus Cuv., Amphiprionichthys Blkr. und Micropus Gray (vielfach verbogener Name). Alle diese meist kleinen Genera gehören nicht zu den Trigloidae, sondern sind Theile der grossen Familie Cottoidae." Kaup, o. c., p. 83.

‡ Enumeratio specierum Piscium hucusque in archipelago Indico observatorum, [etc.] auctore Petro equite a Bleeker, [etc.] Bataviae, typis Langii & Soc. 1859.—The portion quoted is from the "Systematis Piscium naturalis tentamen" (pp. xi-xxxiii), especially pp. xxi, xxiv, xxv.

## Familia 84. Scorpaenoidei.\*

## Subfamilia 1. Scorpaeniformes = Scorpaenini Bp.

Gen. *Pterois* Cuv. (p. 42†), *Pteroidichthys* Blkr. (p. 42), *Sebastes* Cuv. (p. 4), *Scorpaena* L. (p. 41), *Scorpaenopsis* Heck. (p. 41), *Spinacanthus* Ag. (for an huj. loc.?).

## Subfamilia 2. Apistiformes.

Gen. *Pterichthys* Swns. (p. 42), *Apistus* Cuv. (p. 43), *Minous* Cuv. (p. 4), *Cocotropus* Kp., *Choridactylus* Richds., *Trichopleura* Kp., *Sthenopus* Richds., *Aploactis* T.Schl. (p. 44), *Agriopus* Cuv., *Tenionotus* Lac. (p. 4), *Gnathanacanthus* Blkr. (p. 246), *Patecus* Richds., *Amphiprionichthys* Blkr. (p. 44), *Blepsias* C. V., *Peropus* L. Benn.

## Subfamilia 3. Synanceiiformes.

Gen. *Pelor* Cuv. (p. 45), *Synanceia* Bl. Schn. (p. 41), *Synanceium* J. Müll.

## Caterva 2. Platycephalichthyees.

## Ord. 32. Triglae.

## Familia 115. Trigloidei = Dactylei Dum.

Gen. *Peristedion* Lac. (p. 45), *Dactylopterus* Lac. (p. 45), *Trigla* L. (p. 4), *Prionotus* Lac. (p. 247), *Cephalacanthus* Lac., *Petalopteryx* Pict. (for an huj. loc.?)

## Familia 116. Aspidophoroidei = Agonidae Swns.

## Subfamilia 1. Aspidophoriformes.

Gen. *Aspidophorus* Lac., *Hippocephalus* Swns., *Hippocephalichthys* Blk., *Agonus* Bl.

Subfamilia 2. Canthirhynchiformes (*Syngathoideis veris* affines).

Gen. *Aspidophoroides* Lac. (*Canthirhynchus* Swns.).

## Ordo 33. Platycephali.†

## Familia 117. Platycephaloidei = Platycephalinae Swns.

Gen. *Platycephalus* Bl. Schn. (p. 108), *Bembras* Cuv. (p. 253), *Hoplichthys* Cuv. (p. 250).

## Caterva 3. Blennii.

## Ordo 34. Cottii.§

## Familia 120 Cottoidei = Cottini Bp. = Cottidae Swns.

Gen. *Bovichtys* CV., *Cottus* L., *Acanthocottus* Gir., *Aspidocottus* Gir., *Aradius* Gir., *Leptocottus* Gr. [Gir.], *Calyceilepidotus* Ayr., *Scorpaenichthys* Gir., *Clypeocottus* Gir., *Cottopsis* Gir., *Oligocottus* Gir., *Leiocottus* Gir., *Centridermichthys* Richds. (p. 218), *Triglopsis* Gir., *Phobetor* Kro., *Podabrus* Richds. (*Hoplocottus* Kp.), *Hemilepidotus* Cuv., *Hemitripterus* Cuv., *Icelus* Kroy. ?, *Caracanthus* Kroy. ?

## Ordo 35. Blennii.

## Familia 124. Chiroidei = Chiridae Swns.

Gen. *Chirus* Stell. (p. 253), *Oplopoma* Gir., *Ophiodon* Gir.

## Ordo 39. Cyclopteri Cuv. = Plekopteri Dum. = Cyclopteridae Swns.

## Familia 135. Cyclopteroidei.

Gen. *Cyclopterus* Art.

## Familia 136. Gobiesocioidei.

Gen. *Liparis* Art., *Gobiesox* Lac., *Lepadogaster* Gouan, *Sicyases* M. Trosch., *Cotylys* M. Trosch., *Trachelochisimus* Bris., *Sicyogaster* Bris.

\* The only family of the tribe.

† The numbers in brackets after the generic names refer to the pages of the following "Enumeratio specierum Piscium hucusque in archipelago indico observatorum"

‡ Familia 118. Callionymoidei = Callyonimini Bp. Gen. *Callionymus* L. (p. 10) *Harpagifer* Richds., *Chænichthys* Richds.

§ Familia 119. Batrachoidei = Batrachini Bp. Gen. *Batrachus* Klein (p. 123), *Aphichthys* Swns., *Porichthys* Gir.

Some of the families, as thus constituted, have heterogenous elements, viz:

84. *Scorpænoidei*.

*Agriopus* is the representative of a peculiar family—perhaps related to the *Pataceidæ*.

*Patacus* also represents a peculiar family, generally supposed to be related to the *Blenniidæ*.

*Amphiprionichthys* likewise represents a distinct family, the *Caracanthidæ*, as was later recognized by Bleeker.

*Blepsias* and *Peropus* (*Histiocottus* Gill)\* belong to the family *Cottidæ*. The subfamily *Synanceiæformes* was subsequently elevated to family rank by Bleeker himself.

117. *Platycephaloidei*.

*Hoplichthys* does not belong to the same family as *Platycephalus*, but represents a peculiar one.

120. *Cottoidei*.

*Bovichthys* is the type of a family related rather to the *Trachinoidæ* fishes.

*Hemitripterus* is isolated as a peculiar family type.

*Caracanthus* is generically identical with *Amphiprionichthys* which had been referred to the family *Scorpænoidei* by Bleeker on a previous page of the same work.

136. *Gobiesocioidei*.

The genus *Liparis*, referred to the family *Gobiesocioidei*, is not allied to that family, but is the type of a distinct family closely related to the *Cyclopteroidei*.

GÜNTHER.

In 1860, Dr. Albert Günther, in the second volume of the Catalogue of the Acanthopterygian Fishes in the Collection of the British Museum, adopted the family of Cuvier, but with the name of "*Triglidæ*," and divided and subdivided it as follows, the families to which the several genera belong in the system now exhibited being indicated in the right-hand column:

Fam. 10. *Triglidæ*.

First group. HETEROLEPIDINA.

- |  |                 |
|--|-----------------|
| 1. <i>Chirus</i> , <i>Steller</i> .....  | } Hexagrammidæ. |
| 2. <i>Ophiodon</i> , <i>Girard</i> ..... |                 |
| 3. <i>Agrammus</i> , <i>Gthr</i> .....   |                 |
| 4. <i>Zaniolepis</i> , <i>Gir</i> .....  |                 |

\* The name *Peropus* was pre-occupied in Herpetology.

## Second group, SCORPÆNINA.

- |   |   |                 |          |
|---|---|-----------------|----------|
| 5. <i>Sebastes</i> , <i>C. et V.</i> .....        | } | Scorpænidæ.     |          |
| 6. <i>Scorpæna</i> , <i>Artedi</i> .....          |   |                 |          |
| 7. <i>Glyptauchen</i> , <i>Gthr</i> .....         |   |                 |          |
| 8. <i>Pterois</i> , <i>Cuv</i> .....              |   |                 |          |
| 9. <i>Pteroidichthys</i> , <i>Bleek</i> .....     |   |                 |          |
| 10. <i>Tenianotus</i> , <i>Lacep</i> .....        |   |                 |          |
| 11. <i>Centropogon</i> , <i>Gthr</i> .....        |   |                 |          |
| 12. <i>Apistus</i> , <i>C. et V.</i> .....        |   |                 |          |
| 13. <i>Enneapterygius</i> , <i>Rüpp</i> .....     |   |                 | Clinidæ. |
| 14. <i>Pentaroge</i> , <i>Gthr</i> .....          |   |                 | }        |
| 15. <i>Tetraroge</i> , <i>Gthr</i> .....          |   |                 |          |
| 16. <i>Agriopus</i> , <i>C. et V.</i> .....       |   | Congiopodidæ.   |          |
| 17. <i>Posopodasys</i> , <i>Cant</i> .....        | } | Scorpænidæ.     |          |
| 18. <i>Aploactis</i> , <i>Schleg</i> .....        |   |                 |          |
| 19. <i>Trichopleura</i> , <i>Kaup</i> .....       |   |                 |          |
| 20. <i>Hemitripterus</i> , <i>C. et V.</i> .....  |   | Hemitripteridæ. |          |
| 21. <i>Amphiprionichthys</i> , <i>Bleek</i> ..... |   | Caracanthidæ.   |          |
| 22. <i>Synanceidium</i> , <i>Müll</i> .....       | } | Synancecidæ.    |          |
| 23. <i>Synanceia</i> , <i>Schneid</i> .....       |   |                 |          |
| 24. <i>Micropus</i> , <i>Gray</i> .....           |   | Caracanthidæ.   |          |
| 25. <i>Minous</i> , <i>C. et V.</i> .....         |   | Scorpænidæ.     |          |
| 26. <i>Pelor</i> , <i>C. et V.</i> .....          |   | Synancecidæ.    |          |
| 27. <i>Chorismodaetylus</i> , <i>Rich</i> .....   |   | Scorpænidæ.     |          |

## Third group, COTTINA.

- |  |   |                 |
|--|---|-----------------|
| 28. <i>Podabrus</i> , <i>Rich</i> .....          | } | Cottidæ.        |
| 29. <i>Blepsias</i> , <i>C. et V.</i> .....      |   |                 |
| 30. <i>Nautichthys</i> , <i>Gir</i> .....        |   |                 |
| 31. <i>Scorpænichthys</i> , <i>Gir</i> .....     |   |                 |
| 32. <i>Cottus</i> , <i>Artedi</i> .....          |   |                 |
| 33. <i>Centridermichthys</i> , <i>Rich</i> ..... |   |                 |
| 34. <i>Icelus</i> , <i>Kröyer</i> .....          |   |                 |
| 35. <i>Triglops</i> , <i>Reinh</i> .....         |   |                 |
| 36. <i>Hemilepidotus</i> , <i>C. et V.</i> ..... |   |                 |
| 37. <i>Artedius</i> , <i>Gir</i> .....           |   |                 |
| 38. <i>Ptyonotus</i> , <i>Gthr</i> .....         |   | Synanceidæ.     |
| 39. <i>Polycaulus</i> , <i>Gthr</i> .....        |   | Platycephalidæ. |
| 40. <i>Platycephalus</i> , <i>Schneid</i> .....  |   | Hoplichthyidæ.  |
| 41. <i>Hoplichthys</i> , <i>C. et V.</i> .....   |   | Platycephalidæ. |
| 42. <i>Bembras</i> , <i>C. et V.</i> .....       | } | Triglidæ.       |
| 43. <i>Prionotus</i> , <i>Lacep</i> .....        |   |                 |
| 44. <i>Lepidotrigla</i> , <i>Gthr</i> .....      |   |                 |
| 45. <i>Trigla</i> , <i>Artedi</i> .....          |   |                 |

## Fourth group, CATAPHRACTI.

- |   |   |                 |
|---|---|-----------------|
| 46. <i>Agonus</i> , <i>Bl</i> .....             | } | Agonidæ.        |
| 47. <i>Aspidophoroides</i> , <i>Lacep</i> ..... |   |                 |
| 48. <i>Peristethus</i> , <i>Lacep</i> .....     |   | Peristediidæ.   |
| 49. <i>Dactylopterus</i> , <i>Lacep</i> .....   | } | Dactylopteridæ. |
| 50. <i>Cephalacanthus</i> , <i>Lacep</i> .....  |   |                 |
| <i>Xystophorus</i> , <i>Rich</i> .....          |   |                 |

In 1861, Dr. Günther, in the third volume of his catalogue, proposed a new classification of the Acanthopterygian fishes,\* which he distributed among nineteen groups, among which were (1) *Acanthopterygii perciformes*, (8) *Acanthopterygii cotto-scombriformes*, and (10) *Acanthopterygii blenniiformes*. To each of those groups he referred certain of the mail-cheeked fishes, and elevated the four "groups" of the old family to family rank.

The ACANTHOPTERYGII PERCIFORMES were said† to have the "body more or less compressed, elevated or oblong, but not elongate; the vent is remote from the extremity of the tail, behind the ventral fins if they are present; no prominent anal papilla; no super-branchial organ; dorsal fin or fins occupying the greater portion of the back; spinous dorsal well developed, generally with stiff spines, of moderate extent, rather longer than or as long as the soft; the soft anal similar to the soft dorsal, of moderate extent or rather short; ventrals thoracic, with one spine and with four or five rays."

To this group the family of *Scorpenidae* was referred.

The ACANTHOPTERYGII COTTO-SCOMBRIFORMES were said‡ to have "spines developed in one of the fins at least; dorsal fins either contiguous or close together; the spinous dorsal, if present, always short; sometimes modified into tentacles, or into a suetorial disk; soft dorsal always long, if the spinous is absent; anal similarly developed as the soft dorsal, and both generally much longer than the spinous, sometimes terminating in filets; ventrals thoracic or jugular, if present, never modified into an adhesive apparatus; no prominent anal papilla."

In this group were placed the families *Cottidae* and *Cataphracti*, as well as one subsequently added, called *Psychrolutidae*.

The ACANTHOPTERYGII BLENNIIFORMES were defined§ as having the "body low, subcylindrical or compressed, elongate; dorsal fin very long; the spinous portion of the dorsal, if distinct, is very long, as well developed as the soft, or much more; sometimes the entire fin is composed of spines only; anal fin more or less long; caudal fin subtruncated, or rounded if present; ventral fins thoracic or jugular, if present."

In this group was included the family *Heterolepidotidae*.

When the definitions of the several groups thus reproduced are analyzed, and especially when their constituents are taken into consideration, it becomes evident that the essential characteristics of the three groups are to be found in the comparative length of the spinous and soft portions of the dorsal and the length of the anal, while all the

\* Systematic synopsis of the families of the Acanthopterygian fishes. Appendix to v. 3 (10 pp.). The diagnoses of these groups are quoted from a later work of the same author, "An Introduction to the Study of Fishes," 1880. They are essentially the same as in the "Systematic Synopsis."

† Op. cit., p. 374.

‡ Op. cit., p. 438.

§ Op. cit., p. 490.

other characters are interchangeable or alternative, and not necessarily co-ordinated with the essential characters in question.

The manner and extent to which the groups and families recognized by Dr. Günther traverse the superfamilies and families adopted in the present article will appear from the following exhibit, in which the first column gives the groups of Günther, the second the families here adopted, and the third the superfamilies which embrace them.

Groups and Families of Günther.*	Families of Gill.	Superfamilies of Gill.
1. A. perciformes:  Scorpanidæ.....	Scorpanidæ..... Congiopodidæ..... Hemitriptidæ..... Caracanthidæ..... Synanceidæ.....	Scorpanoidea.  Cottoidea.  Scorpanoidea.
8. A. cotto-scombriformes:  Cottidæ.....  Cataphracti.....	Cottidæ..... Synanceidæ..... Platycephalidæ..... Hoplichthyidæ..... Triglidæ..... Rhamphocottidæ..... Agonidæ..... Peristediidæ..... Dactylopteridæ.....	Cottoidea. Scorpanoidea. Platycephaloidea. Trigloidea. Rhamphocottoidea. Agonoidea. Trigloidea. Dactylopteroidea.
10. A. blenniiformes: Heterolepidotidæ.....	Hexagrammidæ.....	Scorpanoidea.

COPE.

In 1871, Professor Cope presented to the American Association for the Advancement of Science an elaborate communication on the systematic relations of the true fishes. It is especially noteworthy for the attention which was paid to modifications of the skeleton, and above all of the pharyngo-branchial apparatus. His order of *Percomorphi* which embraced most of the Acanthopterygians of Cuvier, was divided into seven groups, of which the third was named *Scyphobranchii* and the fifth *Distegi*.

The group SCYPHOBANCHII was named for those Percomorphs which have the "basis cranii simple, no tube, post-temporal furcate; superior pharyngeals shortened; fourth and first generally wanting; third large basin-shaped; second generally scale-like or co-ossified with third scapula with median foramen; dorsal radii usually soft."

To this group, among others, were referred the family *Cottidæ* (with the genera *Uranidea*, *Cottus*, *Leptocottus*, *Hemitripterus*, and *Scorpanichthys*) and the group *Aspidophoridæ*.

The DISTEGI are those Percomorphs having the "basis cranii double with muscular tube, post-temporal bifurcate; scapula with median foramen; basal pectorals three or four, short, quadrate; superior pharyngeal bones four; third always the largest, longitudinal, more or less

\* The *Psychrolutidæ* and *Cyclopteridæ* of Dr. Günther are also true mail-checked fishes, although not so regarded by that gentleman. The *Psychrolutidæ*, indeed, so far as yet known, are not distinguishable from the *Cottidæ*. (See Proc. U. S. Nat. Mus., 1888, pp. 321-327.)

† The *Congiopodidæ* (or *Agriopodidæ*) are not true mail-checked fishes, but rather related to the *Patacidæ*, which have been associated by Dr. Günther with the *Blenniidæ*.

elongate, not articulated to the cranium; inferior pharyngeals separated; dorsal fin with strong spines."

To this group was referred a section (with the genera *Pterois*, *Synanceia*, *Scorpena*, *Pelor* (tube rudimental), *Peristedion*).

#### DARESTE.

In 1872, Mr. Camille Dareste published the result of osteological studies on the bony fishes.\* In regard to the fishes with mailed cheeks, he recognized that there was much diversity among the constituents of the Cuvierian family, and concluded to defer the expression of an opinion on the several types until he could make further studies. He considered that the extension of the suborbitals over the cheeks was an entirely artificial character and unconnected with the variations in the relations of the cranial bones, and that the osteology is much more diversified in the fishes associated under that family than in other groups; he especially instanced the Triglids and Dactylopterids as two groups which exhibit great diversities, although he considered them to be closely related.

It is quite true that the mere extension of the suborbital bones over the cheeks would be of comparatively slight value, and a combination of fishes on that ground alone would be purely artificial; but it is an instance rather of the genius of Cuvier that he wisely limited and checked his conclusions. It is not merely the expansion of the suborbitals, but the development of a specific suborbital in a special way that distinguishes the true mail-cheeked fishes of the normal types, such as the *Scorpenidae* and *Cottidae*. The other groups that have been associated with them, differing in the extent of the suborbital bones, are associated because they possess other characters in common with the least abnormal mail-cheeked fishes. As to the Triglids and Dactylopterids, it is now certain that they are not as closely related as has been supposed, but that the structural characters distinguishing them are of great importance and necessitate their wide separation. But at the same time it must be admitted that they should be approximated, although simply because there is no closer relation to any other form than the *Triglidæ* on the part of the *Dactylopteridæ*.

Mr. Dareste's words are as follows:

La famille des Poissons à joues cuirassées présente une telle variété de formes crâniennes, même dans les genres les plus voisins, qu'il m'a été impossible jusqu'à présent de savoir s'ils appartiennent à un même type, ou s'ils se rattachent à plusieurs types différents. Je dois donc réserver complètement pour un autre travail le groupement de ces animaux; Je me contenterai de faire remarquer d'abord que le caractère des joues cuirassées, c'est-à-dire de l'extension des sous-orbitaires sur les ailes palatine et temporale, est un caractère purement artificiel, puisqu'il se rencontre dans des genres

\* Dareste (C.). Études sur les ostéologiques des poissons osseux. <Comptes rendus Acad. Sc. (Paris), t. 75, pp. 942-946, 1018-1021, 1086-1089, 1172-1175, 1253-1256, 1872.

bien différents, comme l'*Anabas*, le *Myletes* et le *Sudis*; ensuite, que les variations dans les connexions des os crâniens sont bien plus nombreuses que dans d'autres groupes. C'est ce que l'on voit, par exemple, en comparant les *Trigles* et les *Dactyloptères*, bien que ces deux genres soient fort voisins.

#### SEGOND.

In 1873, Dr. D. Segond also published a memoir on the skeletal affinities of fishes,\* in which he especially opposed the views of Dareste. Without going into the merits of the controversy, which appear, however, to be rather or mainly with Dareste, it is only necessary in this place to advert to the fact that Dr. Segond recognized four principal types among fishes, of which the Perch (*Perca*), Mullet (*Mugil*), Carp (*Cyprinus*), and Shark (*Squalus*) are the representative examples. To the Perch type he referred the families *Scorpenidae* and *Cottidae*, and to the type of *Mugil* the family of *Chiridae*. It is certain that in this respect, at least, the classification is entirely negatived by the skeleton, as well as by other characters. His views may be best left to himself for explanation.

La situation donnée aux Trigles dans la dernière édition du Règne animal est des plus caractéristiques; en effet, malgré la spécialité morphologique de la tête, les Trigles ont les plus grandes affinités avec les Perches si l'on considère les parties fondamentales du squelette. Cette affinité se lit facilement chez les Trigles proprement dits, les Scorpiènes, les Pterois, les Agriopes, les Synancées; mais si l'on regarde l'ensemble de la région abdominale des Prionotes, Malarmats, Dactyloptères, Cottés, on sent la nécessité d'établir entre les Trigles une subdivision essentielle, sans rompre cependant les liens généraux si intimes de ce groupe. Si nous confrontons un Scorpiène avec les Percoïdes les mieux caractérisés, nous reconnaissons d'abord la légitimité de la situation de cette famille dans l'arrangement de Cuvier, puis, si nous opposons ce Scorpiène à un Cotte, nous sommes frappés par une différence spéciale dans la forme générale des côtes et aussi par leur disposition et leur connexion avec le corps des vertèbres.

Pour la disposition générale, il faut d'abord confronter un Cotte avec un Trigle, le Chabot par exemple avec le Rouget; on reconnaît alors que, sauf la proportion de l'élément transverse, il y a entre ces deux squelettes de profondes analogies. Mais si l'on veut remarquer ensuite dans l'ensemble des Trigles le mode de connexion de la côte avec le corps de la vertèbre dans les premiers segments abdominaux, on reconnaît alors que la conformation du Chabot n'est que l'extension, à une grande partie, de la colonne abdominale, de la disposition qu'on remarque seulement en avant dans l'ensemble des Trigles. D'après ces observations morphologiques, je pense qu'il faut restaurer l'ancienne distinction de Linné entre les Trigles, les Cottés et les Scorpiènes. En plaçant les Scorpiènes en tête des Trigles comme se rattachant plus directement aux Percoïdes, on les fait suivre des Pterois, Blepsias, Apistes, Agriopes, Pelors, Synancées et Lepisacanthes; viennent ensuite les vrais Trigles, avec les Dactyloptères, Céphalacanthes, Malarmats et Prionotes; enfin les Cottés avec les Platycephales (*Cottus insidiator*), les Hémitriptères et les Hémilepidotes. Quant aux Epinoches, on peut en dehors de leurs caractères génériques, les ranger après les Cottés, tout en leur

\* Segond (D.) Des affinités squelettiques des poissons. < Journ. de l'Anat. et la Phys., 9<sup>e</sup> année, pp. 511-534, 607-627, 1873.

Four principal types are recognized as exemplified in *Perca*, *Mugil*, *Cyprinus*, and *Squalus*.

reconnaissant des relations fondamentales avec les Trigles. Cette dernière situation acceptée par Cuvier est une des preuves les plus intéressantes de l'importance qu'il a dû attacher aux parties fondamentales du squelette. N'ayant pas eu à ma disposition des squelettes d'Oreosome, je les conserverai ici après les Epinoches, sur le dire de Cuvier. (Pp. 532, 533.)

## SAUVAGE.

In 1873, Dr. Sauvage published a special memoir upon the mail-cheeked fishes\* and distributed them among three families—the *Scorpenidae*, *Platycephalidae*, and *Triglidae*. He availed himself of some anatomical characters, but not in all cases happily. The family of *Triglidae*, for example, was characterized by suborbitals covering the whole cheek, but, as Cuvier long ago showed, the suborbitals do not cover the hinder portions of the cheeks in the Dactylopterids. The nasals were said to be soldered in a large plate covering the greater part of the muzzle, but this statement does not appear to be strictly applicable to any of the several types which are combined under the family called by Sauvage *Triglidae*. Another of the characters given to Sauvage's family, the development of four to six ganglionic tubercles at the origin of the spinal marrow, is applicable to the typical Triglids and probably to the Peristediids, but not to the Dactylopterids, and there is no reason to suppose that it belongs to the Agonids. Further, a subdivision of the cataphract Triglids is made into two groups, distinguished by the development of an interparietal bone (as in the Dactylopterids) or the destitution of it (as in the Agonids and Peristediids). In fact, there is no such difference, and the antithesis is probably due to the mal-identification of the bones in the Dactylopterids, where a superficial dermal bone was considered interparietal. The true interparietal, or supra-occipitine, is entirely concealed from the roof of the cranium in the Dactylopterids by a special system of dermal bones, while on the other hand, in the Agonids, it is more than usually well developed (for the mail-cheeked fishes), and extends forwards between the parietals, in part uncovered, and meets the frontals. In the Triglids and the Peristediids it is well developed, but visible only from behind, its anterior or horizontal portion being covered by the overlapping parietals.

Credit is to be given to Dr. Sauvage for the characters derived from the development of the pelvic bones, for using the number of branchiæ, and for utilizing the presence or absence of pseudo-branchiæ as family characters. He has neglected, by name at least, the *Hexagrammidae*, and the genus *Agriopus* has been presented in the *Scorpenidae* as

\* Sauvage (H. Émile). De la classification des poissons qui composent la famille des Triglides (Jones-euirassées de Cuvier et Valenciennes). <Comptes Rendus Acad. Sc. (Paris), t. 77, pp. 723-726, 1873; also, Description de poissons nouveaux ou imparfaitement connus de la collection du muséum d'histoire naturelle. Famille des Scorpenidées, des Platycephalidées et des Triglidées. <Nouv. Archives Mus. Hist. Nat., Paris (2), t. 1, pp. 109-153, pl. 1, 2, 1878.

by all his predecessors. His diagnoses of the several families are as follows:

I. SCORPENIDÆ: Dentition faible, dents en velours, pas de canines. Sous-orbitaires s'articulant d'une manière mobile avec le préopercule, ne couvrant jamais toute la jône; os nasaux libres et petits. Peau, ou nue ou revêtue d'écaillés, parfois épineuse, jamais cuirassée; ventrales thoraciques supportées par un os du bassin long, les deux os étant en contact et soudés. Des pseudobranchies: trois branchies entières et une demi-branchie; quatre fentes branchiostèges [branchiaux]. Pas de tubercules sur la moelle, en arrière du *calamus scriptorius*.

A. SCORPÆNI: Corps revêtu d'écaillés ordinaires (*Sebastes*, *Scorpana*, *Pterois*, *Taxionotus*, groupe des *Apistes*).

B. COTTINI: Corps ou nu ou portant des écaillés épineuses (*Hemitripterus*, *Synancidium*, *Synanceia*, *Minous*, *Pelor*, groupe des *Cottes*, *Iclus*, *Triglops*, *Polycaulus*, *Hemilepidotus*).

II. PLATYCEPHALIDÆ: Tête aplatie et comme écrasée. Corps aplati antérieurement. Dentition faible, pas de canines. Deux dorsales; la première épine séparée des autres. Ventrales thoraciques, largement séparées; os du bassin jamais réunis ni soudés, laissant entre eux un très grand intervalle (*Platycephalus*).

III. TRIGLIDÆ: Sous-orbitaire, s'articulant d'une manière presque fixe, ou du moins à peine mobile avec le préopercule, et couvrant toute la jône. Nasaux soudés en grande plaque, couvrant la plus grande partie du museau. Ventrales thoraciques et réunies. Pseudobranchies; arcs branchiaux complets; cinq fentes branchiostèges [branchiaux]. De quatre à six tubercules ganglionnaires à l'origine de la moelle.

A. TRIGLINI. 1<sup>er</sup> groupe, *Trigli*: corps revêtu d'écaillés ordinaires (*Trigla*, *Lepidotrigla*, *Prionotus*, *Bembras*); 2<sup>e</sup> groupe: corps ayant des écaillés et des plaques: *Hoplichthyi* (*Hoplichthys*).

B. CATAPHRACTI. 1<sup>er</sup> groupe: un interpariétal: *Dactylopteri* (*Dactylopterus*, *Cephalacanthus*); 2<sup>e</sup> groupe: pas d'interpariétal: *Peristethi* (*Agonus*, *Agonomalus*, *Peristhedion*).

#### JORDAN AND GILBERT.

Among the most recent investigators of the mail cheeked fishes have been Professors Jordan and Gilbert. They have added greatly to our knowledge of the American species and have unveiled the richness of the group represented in the North Pacific. In their "Synopsis of the Fishes of North America" (p. 640), they have advocated the naturalness of the group. They maintained that "the *Chiridae*, *Scorpenidae*, *Cottidae*, *Agonidae*, *Triglidæ*, *Liparididae*, and *Cyclopteridæ* form a closely-related series (*Cataphracti*), and are distinguished from all the other *Acanthopteri* by the presence of the suborbital stay. Different writers have widely separated some of the members of the group from the others, but the relations of each, especially of the *Scorpenidae*, *Agonidae*, and *Liparididae* with the *Cottidae* are so close that it is difficult to draw satisfactory boundary lines." Detailed descriptions are given of each of the families thus enumerated; but, inasmuch as their work is confined to the North American fishes, they did not take cognizance of the types which form the families *Caracanthidae*, *Platycephalidae*, and *Hoplichthyidae*, and, from their descriptions, it is not certain what would be done by them with the representatives of those families. The cardinal characters given to the families recognized by them are the comparative armature of the head, the development or want of slit behind the fourth

branchial arch, and the relations of the gill-membrane of the respective sides. In their analysis (p. 401) they have represented the relationships and characteristics of the several families in the following manner:

DD. Suborbital with bony stay. (Cottiform fishes.)

v. Head not mailed.

x. Slit behind fourth gill large; body evenly scaled.....*Chirida*

xx. Slit behind fourth gill small or wanting.

y. Gill-membranes separate, free from isthmus; ventral fins normally formed, mostly 1, 5.....*Scorpenidae*.

yy. Gill-membranes broadly joined, attached to the isthmus or not; ventral fins variously imperfect.....*Cottidae*.

vv. Head mailed, externally bony.

z. Ventrals few-rayed, close together; last gill-slit obsolete.....*Agonida*.

zz. Ventrals 1, 4, or 1, 5, usually wide apart; last gill-slit large.....*Triglida*.

Those having a suborbital stay but having the "breast with a sucking-disk" are divided into two families:

b. Skin smooth; vertebræ very numerous.....*Liparidida*.

bb. Skin tubercular; vertebræ rather few.....*Cyclopterida*.

It will thus be seen that the characteristics of the families given by Professors Jordan and Gilbert are not of great importance, and we need not be surprised, therefore, that they considered that "the relations of each, especially of the *Scorpenidae*, *Agonida*, and *Liparidida* with the *Cottida* are so close that it is difficult to draw satisfactory boundary lines." The characteristics assigned by them to the families are, however, co-ordinate with osteological characters of far greater importance which confirm their families so far as they go, but it will become evident hereafter they have not gone far enough, and the families require to be multiplied. The characters of the additional families to be admitted are of fundamental importance and greater than those assigned by the authors to the families admitted by them.

#### OWEN.

Among the statements relating to the skeleton, one occurs which should not be passed over in silence, and which may be aptly noticed in this place. According to Professor Owen (*Anatomy of Vertebrates*, v. I, p. 111), the subtectals or "*orbitosphenoids*" are "sometimes represented by a descending plate of the frontal, as in the Garpike, or by unossified cartilage, as in mail checked fishes."

This statement must surely be the result of some confusion of notes or misapplication of the name "mail-checked fishes." In all the species of that series which I have examined (and which must have been many more than observed by Professor Owen), the so-called orbitosphenoids or subtectals are very distinctly developed, and the modifications of those bones have been found to be very useful in the determination of the relationships of the species, as well as for diagnostic purposes. Whatever may have been the basis of observations, the statement at any rate is altogether too sweeping and vague.

## PRINCIPLES OF CLASSIFICATION.

The question now comes up, which of the views entertained respecting the classification of the mail-cheeked fishes and promulgated are the more correct? Three of the systems adverted to may be specially considered: (1) the Cuvierian, in which all the mail-cheeked fishes were associated closely together; (2) the Güntherian, wherein those fishes are segregated according to the relative proportions of the spinous and soft parts of the dorsal fin; or (3) the Copean, in which the primary distinction is based upon the development or non-development of the so-called muscular tube, or, in other words, whether there is a double or single "basis cranii," and whether there are two or four epipharyngeal bones on each side.

Considering the various forms with reference to the development of the dorsal fin, we find that at least some forms (*Caracanthi*) that have been referred to the family *Scorpenidae* by Günther actually have the soft portion of the dorsal longer than the spinous portion, and not, as the definition requires, the proportions reversed. We also find that it is difficult in practice to fit the definitions to certain fishes, for there is really a gradation, if we take into account all those which have been thus distributed into the four Güntherian families, between those forms with an elongated spinous portion and those with an abbreviated spinous portion of the dorsal fin, as well as those having a short or long anal fin. It is found also that the groups of Günther traverse those proposed by Cope, and that the characters derived from the structure of the dorsal fin are not co-ordinated with those of the skeleton as signalized by Cope or by nature. Thus it appears that the *Triglidae*, which, by Günther, are associated with *Cottidae*, are by Cope separated from the latter and approximated next to the *Scorpenidae*, while, on the other hand, the genus *Hemitripterus*, which, by Günther, is referred to the family *Scorpenidae*, is by Cope considered to be one of the constituents of the family *Cottidae*.

Long ago the present author had considered the questions thus involved and had been led to the conclusion that the various mail-cheeked fishes had been, on the whole, naturally associated by Cuvier, although of course, in accordance with modern views, the species constituting the family of Cuvier required to be segregated into at least a number of families. He had found that the development of the dorsal fin was of much less value than had been claimed for it by Günther, and that the definitions of Cope referring to the double or single basis cranii were inapplicable in the classification of these fishes.

All of the *Cottidae* naturally have a double "basis cranii" although less developed than in the *Scorpenidae*, nor would the term "rudimentary," even, be applicable to the condition exemplified in the *Cottidae* whatever may be the sense in which that word has been used by Professor Cope with reference to the genus *Pelor*, which is said to have the

“tube rudimentary.” This so-called “tube,” be it remarked, is a chamber for the insertion of the *rectus* muscles of the eye; this is isolated from the brain cavity by the development of a platform from the basi-occipitine continuous with horizontal ridges or shelves diverging from the inner walls of the prootic bones and meeting along the middle, thus constituting a roof for the muscular chamber and a floor for the cranial cavity. This special chamber may be called the MYODOME.\* The chamber, as can be readily seen by bisection of the skull of any Cottid, is too well developed to be called “rudimentary,” and in *Scorpenichthys*, also referred to by Professor Cope, it is actually little less if not indeed quite as well developed as in the *Scorpenida*, and does not differ from that of the *Trigloidea*, and only differs from that of the *Scorpenida* by the transverse anterior margin of the shelf and the absence of the dichost or so-called basi-sphenoid bone. We have, in fact, among the mail-cheeked fishes almost all transitions. In the *Hexagrammide* or *Chiride* the basi-sphenoid bone is almost if not quite as well developed as in the majority of acanthopterygian fishes, and sends down processes to the parasphenoid. In the *Scorpenida* it is developed mostly as a triangular element in front, and has no descending process, while in the *Cottide* it appears to be entirely absent. In all of these fishes, however, the muscular cavity is differentiated, and the only difference, exclusive of the presence or absence of the dichost or basi-sphenoid, is the relative extension forwards or projection of the roof of the muscular cavity. The principal deviations from the standard occur in the Hemitripteriids, the Cyclopterids, and the Dactylopterids.

So great is the variation in this group, and so widely do some types deviate from the pattern exhibited by the typical acanthopterygian fishes, that a number of exceptions are manifested by various forms to the characters by which Professor Cope has restricted the major groups including them. This proposition holds true not only as to the subordinal or equivalent groups, but as to the orders and even the tribes.

The tribe of Physoclysti (Physoclisti) is defined as having, among other characters, “the parietals entirely separated by the supra-occipital.” This character, however, is not exemplified by the Hemitripteriids, Cottids, Triglids, and Peristediids, for in all those families the parietal bones approach and join each other by suture overlapping the supra-occipital.

The order of Percomorphi is defined as having, among other characteristics, the “epiotics normal; no interelavicles; post-temporal not co-ossified with the cranium; basal pectoral radii not enlarged,” and “the sub- and inter-operculum present, plate-like.” Exceptions occur among the mail-cheeked fishes to each of these generalizations.

The epiotics can not be said to be normal in such forms as the *Agonida*, *Triglida*, *Peristediida*, and *Dactylopterida*, in which they are specially modified for union with the supra temporals and otherwise.

\* Myodome: Gr. *μυα* (*μυος*), muscle; *δομος*, chamber.

Interclavicles have been attributed to the *Cottidae*, by Professor Parker.

The post-temporals are firmly co-ossified with the cranium in at least the *Triglidae*, *Peristediidae*, and *Dactylopteridae*, and to such an extent that it is very difficult to trace the line of union between them, the sutures being less distinct than those between others of the normal bones of the cranium.

The "basal pectoral radii" or actinosts are much enlarged in the *Hemitripteridae* and *Cottidae*, whereof a portion are joined directly to the proscapula and widely separate the hypercoracoid and hypocoracoid.

The inter operculum is entirely separate from the other opercular bones in the Peristediids and Dactylopterids. In the Peristediids they are elongated and blade-like laminar bones, but in the Dactylopterids they are atrophied and reduced to osselets under the extended anterior portion of the preoperculum just behind the lower jaw.

The muscular tube whose presence or absence determines the position in Professor Cope's system of various forms is present in all of the typical mail-cheeked fishes except the *Hemitripteridae* and *Dactylopteridae*, but in the former it is replaced by a modified device, while in the latter it is wholly wanting; it is as well developed in the Cottids, referred by Cope to the *Scyphobranchii* as in the Triglids and Peristediids placed by him among the *Distegi*.

It is indeed more than probable that the real reason which influenced Professor Cope to segregate the mail-cheeked fishes as he did was not the presence or absence of the myodome, but the development of two or four epipharyngeals.

The number of epipharyngeals, however, is not co-ordinate with the development or atrophy of the myodome, as may perhaps have been assumed. In this connection, too, it may be explained that the rudimentary and edentulous epipharyngeals have been counted by Professor Cope as well as the dentigerous ones. There is only one pair of dentigerous epipharyngeals in the Cottids and Hemitripterids, and there are three in the typical Scorpenids, Triglids, and related forms. But in forms otherwise closely agreeing with the typical *Scorpanidae* in osteological characters—the *Apistinae*—there are only single epipharyngeals, as in the Cottids. We are consequently led to the conclusion that the development or non-development of a myodome and the number of epipharyngeals are of less systematic importance than Professor Cope (quite naturally) inferred.

If the deviations from the diagnoses of Professor Cope have been thus detailed, it is not in the line of criticism, but because that accomplished zoologist has so well studied the osteological characteristics of the fishes. The uniformity in respect to the parts commented upon is so great in most of the forms belonging to the groups diagnosed that it has impressed him, perhaps unduly, and, by the contrast, the wide and

exceptional range of variation among the mail-cheeked fishes can be effectively presented to the general student of ichthyology.

It may be asked, what is the reason for the great difference between the system herein proposed for the mail-cheeked fishes and those followed by previous writers? It is sufficient to reply that we have been guided by a consideration of the entire structure and by the assumption that the whole is greater than any of its parts. In some, at least, of the previous essays at subdivision and segregation of the group, the principle that a part is greater than its whole, although of course not avowed, has been practically carried out. In this connection we may recall the principles of the father of natural history, which have too often been disobeyed, and which deserve re-enforcement, even though their formulator himself often sinned against them:

Quæ in uno genere ad genus stabiliendum valent, minime idem in altero necessario præstant.

Scias characterem non constitnere genus sed genus characterem; characterem fluere e genere, non genus e characterem; characterem non esse, ut genus fiat, sed ut genus noseatur. (Linn., Phil. Bot., § 169.)

#### COMPARISON.

It is interesting and instructive to note the different manner in which the group of mail-cheeked fishes has been treated by three prominent investigators.

Cuvier, the man of great genius and talents, amongst the scattered masses of fishes which he was called upon to consider, noticed the superficial resemblance between the various mail-cheeked fishes, and his search for a common character was rewarded by the discovery of the development of the enlarged elements of the suborbital chain, on account of which he named the group designated by him as the family of "mail-cheeked" fishes (*Joues-cuirassées*.)

Günther, a man meritorious for industry, but deficient in genius and scientific tact, failed to appreciate a generalization already duly formulated. Impressed by the most superficial characters, he ignored the generalization of Cuvier, widely separated the constituents of the group recognized by the great naturalist, and associated the scattered members with forms with which they have little or no relationship. This divorce has been dissented from or protested against as unnatural by almost all the French and Scandinavian as well as American ichthyologists. So potent, however, has been the influence of a great work—great in the sense of voluminous and as the outcome of laborious industry—that the most unnatural classification proposed by the anglicized ichthyologist has been followed by almost all the English and German naturalists.

Kaup, the "nature-philosopher," applied fancy to his consideration of the group, and its results have already been exhibited.

## GENETIC RELATIONSHIPS.

In view of the wide range of variation that has been shown to be manifested by the various members of the great group of mail-cheeked fishes, it may be considered that it is not a natural group. In one sense it is not. The differences are certainly sufficient to justify the segregation of its elements not only into a number of families, but into seven superfamilies. Nevertheless the relations between the various members are such as to indicate that they form a natural although much interrupted series, and the genius of Cuvier is apparently justified by a detailed examination of the anatomy.

The most generalized of the mail-cheeked fishes appear to be the Scorpenoidea; these have the general form of ordinary fishes, like the Seranids, Sparids, and numerous others. Osteology also corroborates the nearer relationship of those forms to the normal acanthopterygian fishes. If we look around among those normal forms for the nearest relatives of the mail-cheeked fishes, in the present state of our knowledge, we appear to at least approximate the truth in claiming for them a nearer relationship with the Cirritids than any others. This view, however, is simply hypothetical and can not be considered to be established until we become better acquainted with the anatomy of the various members of the suborder Acanthopterygii. Which of the Scorpenoidea are the most generalized is a more difficult question to answer.

In some respects the Chirids, or Hexagrammids, appear to be more generalized than the Scorpenids. They are less armed with spines than the other representatives of the great group of mail-cheeked fishes, and, what is still more significant, the dihost or basi-sphenoid is more developed and approaches in form that exemplified in the normal Acanthopterygians; nevertheless, the parietal bones converge towards the front so as to almost, if not quite, touch over the front of the supra-occipitine. The parasphenoid sends elongated processes upwards to meet corresponding processes of the subtectals or orbito-sphenoids. In both of these characters they deviate from the Scorpenids and approach the Cottids. For this reason, therefore, they are placed after the Scorpenids and before the Cottids. The comparatively slight value of the approximation or separation of the parietals thus appears and demonstrates that it is inadvisable to separate widely groups resembling each other in so many characters because of such differences.

An elongate spinous portion of the dorsal fin and an inversely short rayed portion are developed in the Hemitripterygids; nevertheless, those fishes agree in most osteological as well as most external characters with the Cottids; consequently the unnaturalness of removing them afar from the Cottids and associating them with the Scorpenids, as well as the slight value of the relative proportions of the spinous and rayed portions of the dorsal fin, becomes evident.

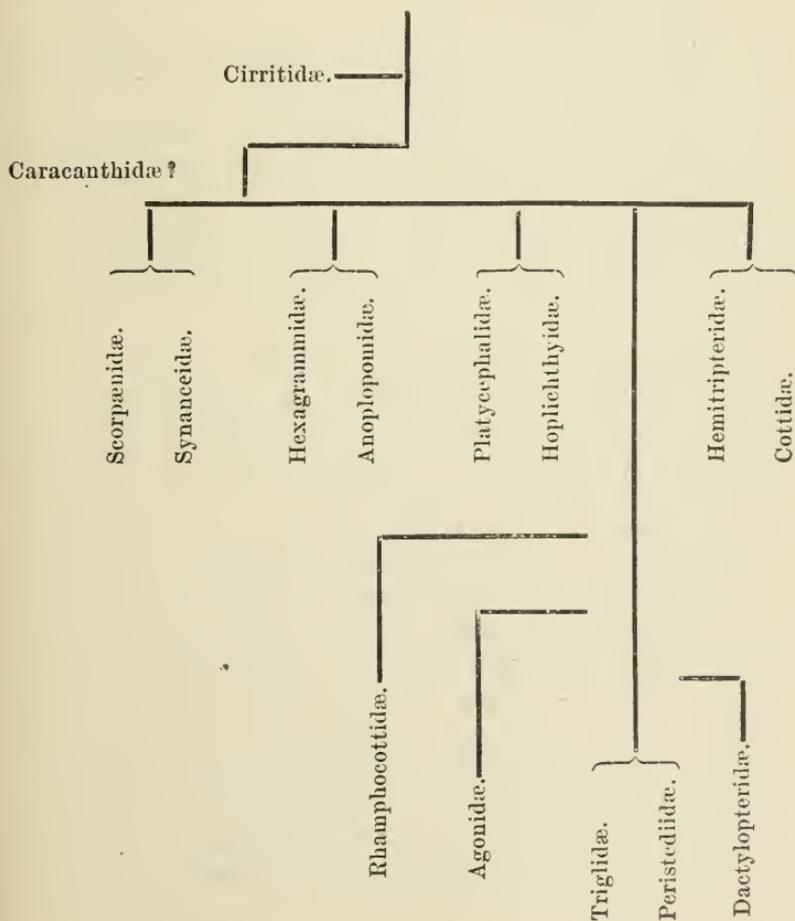
The osteological characters of the Platycephalids and Hoplichthyids

are imperfectly known, and it remains for future investigation to determine what are their exact relationships and characteristics.

The Triglids and Peristediids depart very widely from the other groups, as will become hereafter manifest, but, notwithstanding, their relationships appear to be more intimate with the generalized mail-cheeked fishes than with any other group.

The Dactylopterids depart still more from all other fishes than do the Trigloidea. We look in vain, however, for any nearer relation of those fishes than the Trigloidea, and consequently it may be assumed that they are the derivatives from a type from which the Triglids have least diverged.

In fine, the relationships of the various families of mail-cheeked fishes, in the present state of our knowledge, may be expressed in the following genealogical tree in which the left-hand branch in each case represents the more generalized type of each pair :



In this connection it seems advisable to refer to views enunciated by Prof. W. Kitchen Parker. That eminent anatomist has proposed to

divide the "Pisces Acanthopteri" of Müller" into "an atypical and a typical assemblage. The former should take in the Trigloid, Cottoid, Gobioid, and Lophioid families; all these are more or less aberrant and come into proximity to the *sub-ganoid* types, and even to the true Ganoidei."\*

If the contention of the present author is correct, the views of Professor Parker are wholly inadmissible. Far from approximating the Ganoids, the mail-cheeked fishes are among the most remote from them, and any characters in which they may be supposed to resemble them, such as the enlargement and development of scales into plates, are secondary and not primitive features. Still more specialized and remote from the Ganoids are the "Gobioid and Lophioid families." The evidence in favor of this contention appears to be overwhelming. Professor Parker considers that the "*Cottus bubalis*," his "first instance, is the best connecting link between the Ganoid and sub-ganoid types already described and the true typical Teleostei, the Percoids and their allies; moreover, another Cottoid—the Pogge (*Agonus cataphractus*)—re-assumes the ganoid covering."† It appears to me conclusive that the Scorpænoids are the most generalized and least divergent of the series and derived from (and not ancestral or subancestral to) the perciform fishes, while it is equally indisputable that the Cottoids are divergent in a still greater degree in the road of specialization foreshadowed in the Scorpænoids; and to even still greater a degree are the Agonoids, the Trigloids, and the Dactylopteroids divergent.

#### SYSTEMATIC SUMMARY.

As it has been shown in the preceding pages that the characters made use of by previous ichthyologists, based as well on external features as on anatomical peculiarities, are not co-ordinated in the manner claimed, it became necessary to examine in detail the various types that have been referred to the mail-cheeked fishes. This has been done by means of the skeletons and alcoholic collections in the National Museum. I have thus been enabled to study the skeletons of representatives of all the families that have been admitted except two, the *Caracanthidae* and the *Rhamphocottidae*. The former family is not represented in the National Museum even by an alcoholic specimen, but of the latter there is a moderately well preserved example which permits an interpretation, at least, of skeletal characters. It is quite probable that the *Caracanthidae* represent a peculiar superfamily, while the *Rhamphocottidae*, if I interpret correctly their characters, also represent a superfamily. The following synopsis exhibits the chief, or at least the most obvious, characteristics of the several superfamilies. It will be

\* Parker (W. K.). A Monograph on the Structure and Development of the Shoulder-girdle and Sternum in the Vertebrata. London, 1868. (p. 42.)

† Parker, *op. cit.*, p. 43.

seen that most of the characters used have not before been employed in the taxonomy of the group, and that some are specially noteworthy, inasmuch as they militate against the conceptions of uniformity within the order even to which the group belongs.

## I. ACANTHOPTERYGII BUCCIS LORICATIS.

Acanthopterygians with the scapular arch normal, the post-temporal<sup>1</sup> and postero-temporal<sup>2</sup> forming part, and the latter intervening between the post-temporal and the proscapula.<sup>3</sup> Infraorbital chain with all bones entering into the orbital margin and functional, only partially extended over the check; with the third bone hypertrophied and developed as a stay impinging on the anterior wall of the preoperculum; post-temporal variously connected with the epiotic and pterotic; intermaxillines<sup>4</sup> with well-developed ascending pedicles gliding over the front of the prosethmoid.<sup>5</sup>

### SYNOPSIS.

A. Myodome<sup>6</sup> more or less developed.

B. Post-temporal bifurcate and connected with the cranium by its processes in normal manner.

C. Body and head compressed or moderately depressed.

D. Actinosts<sup>7</sup> moderate and inserted on posterior edges of hypercoracoid<sup>8</sup> and hypocoracoid;<sup>9</sup> ribs, typically, borne on enlarged parapophyses.....

SCORPENOIDEA.

DD. Actinosts large and partly intervening between the hypercoracoid and hypocoracoid; ribs sessile on the vertebræ.....

COTTOIDEA.

CC. Body and head much depressed.....

PLATYCEPHALOIDEA.

BB. Post-temporal expanded and connected with the cranium by extensive suture.

c. Anus submedian; ventrals subabdominal; exoskeleton developed as spiniform prickles.....

RHAMPHOCOTTOIDEA.

cc. Anus thoracic; ventrals subbrachial; exoskeleton developed as plates arranged in about 8 longitudinal rows.....

AGONOIDEA.

AA. Myodome completely wanting.....

CYCLOPTEROIDEA.

## II. CRANIOMI.

Teleocephali with the scapular arch abnormal, the post-temporal forming an integral part of the cranium and the postero-temporal crowded out of place by the side of the proscapula above or at the edge of the post-temporal.

<sup>1</sup> Post-temporal (Parker) = Suprascapula (Cuv.).

<sup>2</sup> Postero-temporal (Gill, 1872) = Scapula (Cuv.).

<sup>3</sup> Proscapula (Gill, 1872) = Humeral (Cuv.) = Coracoid (Owen.).

<sup>4</sup> Intermaxillines (Gill, 1888) = Intermaxillaries (auct. pl.).

<sup>5</sup> Prosethmoid (Gill, 1888) = Ethmoid (auct. pl.).

<sup>6</sup> Myodome (Gill, 1888) = Muscular tube for ocular muscles.

<sup>7</sup> Actinosts (Gill, 1872) = Carpals (auct. vet.) = Brachials (Parker).

<sup>8</sup> Hypercoracoid (Gill, 1872) = Radial (Cuv.) = Scapula (Parker).

<sup>9</sup> Hypocoracoid (Gill, 1872) = Cubital (Cuv.) = Coracoid (Parker).

## SYNOPSIS.

- A. Mydome developed and cranial cavity open in front; prosethmoid and antea\* normally connected by suture. Infraorbital chain with its anterior bones excluded from the orbit and functional as rostralateral, the series covering the cheeks, the third a large buccal bone articulating with the anterior wall of the preoperculum; post-temporal suturally connected with the epiotic and pterotic by inferior processes, and with the upper surface forming an integral part of the roof of the cranium; intermaxillines with the ascending pedicles atrophied and connected with the knob of the antea by ligament. Postero-temporal contiguous to the proscapula .....TRIGLOIDEA.
- AA. Mydome undeveloped, the cranial cavity mostly closed in front by expansions from the subtectal† suturally connected with corresponding expansions of the pterotics and the parasphenoid; prosethmoid and antea entirely disconnected, leaving a capacious rostral chamber opening backwards mesially into the interorbital region. Infraorbital chain, with its second and third bones crowded out of the orbital margin by junction of the first and fourth, and leaving a wide interval between the suborbitals and the preoperculum; the first very long and extending backwards, the second under the fourth and the third developed as a small special bone (pontinal) bridging the interval between the second suborbital and the antero-inferior angle of the preoperculum; post-temporal suturally connected with the posterior bones of the cranium, and with the upper surface forming a large part of the roof of the head; intermaxillines with well-developed ascending pedicles gliding into the cavity between the antea and prosethmoid. Postero-temporal distant from the proscapula, and manifest as an ossicle on the edge of the post-temporal .....DACTYLOPTEROIDEA.†

The superfamily SCORPENOIDEA includes the families *Scorpenidae*, *Synanceidae*, *Hexagrammidae* (or *Chiridae*), and *Anoplopomidae*. The *Caracanthidae* are generally associated with the *Scorpenidae* and may belong to the superfamily, but this is doubtful.

The superfamily COTTOIDEA embraces the families *Hemitripterae* and *Cottidae*.

The superfamily PLATYCEPHALOIDEA is represented by the families *Platycephalidae* and *Hoplichthyidae*. Probably *Bembras* is the type of an additional family, but I have not been able to examine its skeleton.

The superfamily RHAMPHOCOTTOIDEA is represented by one family (*Rhamphocottidae*), with a single genus (*Rhamphocottus*), and species (*R. Richardsonii*).

The superfamily AGONOIDEA is manifested in the single family *Agonidae*.

The superfamily CYCLOPTEROIDEA has two families, *Cyclopteridae* and *Liparidae*.

The superfamily TRIGLOIDEA includes the families *Triglidae* and *Peristediidae*.

The superfamily DACTYLOPTEROIDEA is represented only by the family *Dactylopteridae*.

\*Antea (Gill, 1888) = Vomer (auct. pl.).

†Subtectal (Gill, 1888) = Orbitosphenoid (Owen).

‡The synoptical tables were published in part in a preliminary note on "The Primary Groups of Mail-cheeked Fishes," in the *American Naturalist* for April, 1888 (issued about May 22), v. 22, pp. 356-358.

The *Trigloidea* and *Dactylopteroidea* are segregated as representative of a peculiar suborder CRANIOMI.

It is expected that descriptions of the several superfamilies and included families will be soon published.

Meanwhile, the reproductions of previous classifications and the comments on them will convey additional information respecting the limits of the several families and the characters which are and are not applicable to them. The following table will also indicate the families that have been admitted from time to time among the mail-checked fishes, with references to the pages of the works in which they were published at the dates given at the head of each column. The synonyms are extended on a line from the families of which they are homonyms, but the limits of course are various and can not be conveniently indicated in the table.

Families.	Dum., 1806.	Raf., 1810.	Risso, 1826.	Cuv., 1829.	Bon., 1832.	Bon., 1850.	Adams, 1854.	Blekr., 1859.	Gthr., 1860.	Gill, 1872.	J. & G., 1882.
Caracanthidæ .....										(22)	
Scorpenidæ .....	1130		6109				101	9xxi	(17)	6	650
Synanceidæ .....							8102			(22)	
Chiridæ .....							97	10xxv	(18)	6	640
Anoplopomidæ .....										(22)	
Hemipteridæ .....										(22)	
Cottidæ .....							102	11xxiv	(19)	6	682
Platycephalidæ .....							102	12xxiv		6	
Hoplichthyidæ .....										(22)	
Rhamphocottidæ .....											
Agonidæ .....							102	13xxiv	(20)	6	722
Liparididæ .....								14xxvi	(21)	5	738
Cyclopteridæ .....	2109			6344	38	7	96	15xxvi	(21)	5	744
Triglidæ .....	2130	428	109	7158	32	7	101	16xxiv	(19)	6	731
Peristedidæ .....										(20)	
Dactylopteridæ .....										(23)	(23)

- <sup>1</sup> Cephalotes D.
- <sup>2</sup> Plecopteres D.
- <sup>3</sup> Dactyles D.
- <sup>4</sup> Dactipli Raf.
- <sup>5</sup> Scorpenides R.
- <sup>6</sup> Discoboles C.
- <sup>7</sup> Jous cuirassées.
- <sup>8</sup> Synanchidæ Ad.
- <sup>9</sup> Scorpenoidei B.
- <sup>10</sup> Chiroidei B.
- <sup>11</sup> Cottoidei B.
- <sup>12</sup> Platycephaloidei B.
- <sup>13</sup> Aspidophoroidei B.
- <sup>14</sup> Gobiesoidei B.
- <sup>15</sup> Cyclopteroidei B.
- <sup>16</sup> Trigloidei B.
- <sup>17</sup> Scorpenina G.
- <sup>18</sup> Heterolepidina G.
- <sup>19</sup> Cottidæ + Psychrolutidæ G.
- <sup>20</sup> Cataphracti G.
- <sup>21</sup> Discoboli G.
- <sup>22</sup> Gill, Standard Nat. Hist., v. 3, 1885.
- <sup>23</sup> Cephalacanthidæ or Dactylopteridæ Gill, Standard Nat. Hist., v. 3, p. 252, 1885.
- <sup>24</sup> Cephalacanthidæ Jordan, Man. Vert. N. A., p. 151, 1888.

NAMES OF FAMILIES.

The works to which reference is made in the preceding table are as follows:

1806. Zoologie analytique, ou méthode naturelle de classification des animaux, rendue plus facile à l'aide de tableaux synoptiques; par A. M. Constant DUMÉRIEL, [etc.]. Paris, Allais, libraire, Quai des Augustins, No. 39. MDCCCVI. [5vo., xxxii (+1 l.) + 344 pp.]

Families were first indicated in this work and named after supposed essential characters, e. g., *Céphalotes*, *Dactylés*, *Plecoptères*.

1810. Indice d'ittologia siciliana ossia catalogo metodico dei nomi latini, italiani, e siciliani dei pesci, che si rinvencono in Sicilia, disposti secondo un metodo

naturale [etc.]. Opuscolo del signore C. S. RAFINESQUE SCHMALTZ.—Messina. Presso Giovanni del Nobolo. Con approvazione. 1810. [8vo, 70 pp., 2 folded pl.]

Families, called orders (ordine), were recognized and chiefly named after typical genera, *e. g.*, *Percidi Scaridi*.

1826. Histoire naturelle des principales productions de l'Europe méridionale et particulièrement de celles des environs de Nice et des Alpes maritimes: par A. RISSO, [etc.]. Tome troisième.—A Paris, chez F. G. Levrault, libraire, [etc.]. 1826. [8vo.]

Most of the volume (pp. 97-480, fig. 4 on pl. 2 to fig. 50 on pl. 16) was devoted to the fishes. Various families were first instituted in this work, *e. g.*, *Scorpenides*, *Triglides*.

1829. Le Règne Animal distribué d'après son organisation, pour servir de base à l'histoire naturelle des animaux, et d'introduction à l'anatomie comparée, par Georges Cuvier. [2<sup>e</sup> ed.]. Paris. 1829.

1832. Saggio di una distribuzione metodica degli Animali Vertebrati di Carlo Luciano BONAPARTE, Principe di Musignano. Roma. Presso Antonio Boulzaler, 1831-32. [8vo., 86 pp.]

A translation of a part of the preceding article was soon published, viz: Versuch einer methodischen Vertheilung der Wirbelthiere mit kaltem Blut von Carl Lucian BONAPARTE, Prinz von Musignano. <Isis. 1833, col. 1183-1229.

36 families with 62 subfamilies and 15 families not subdivided (= 77 subfamilies) are named and defined.

1850. Conspectus systematis Ichthyologiæ Caroli Luciani BONAPARTE. Editio reformata. 1850. Apud E. T. Brill Academiæ Typographum. [Lugduni Batavorum.] [A large sheet with names of all divisions.]

21 orders, 82 families, and 185 subfamilies are admitted.

1854. A manual of natural history for the use of travellers; being a description of the families of the Animal and Vegetable Kingdoms: [etc.]. By Arthur Adams, M. R. C. S.; E. L. S.; M. R. E. S., Stettin; William Balfour Baikie, M. D., [etc.] and Charles Barrow, [etc.]. London: John Van Voorst, Paternoster Row. MDCCLIV. [12mo, viii, 749 pp.]

The families and major groups of fishes are defined by Adams (pp. 78-110).

The work is of no real value, and Swainson is regarded as an authority and subfamilies defined by him elevated to the rank of families. The only importance of the work results from the fact that the names of several families appear in it for the first time.

1859. Enumeratio specierum piscium hucusque in archipelago indico observatorum, [etc.], auctore PETRO equite a BLEEKER, [etc.]. Bataviae, typis Langii & soc. 1859. [4<sup>o</sup>, xxxvi, 276 pp.]

1861. Catalogue of Fishes in the British Museum. By ALBERT GÜNTHER, M. A., M. D., etc. . . . Volume third. London: printed by order of the trustees. 1861. [8<sup>o</sup> (gen. title x), xxv, 586 pp.]

1872. Arrangement of the families of Fishes, or classes Pisces, Marsipobranchii, and Leptocardii. Prepared for the Smithsonian Institution. By THEODORE GILL, M. D., Ph. D. Washington: published by the Smithsonian Institution. November, 1872. (Smithsonian Miscellaneous Collections. 247.—8<sup>o</sup>, xlvi, 49 pp.)

1882. Synopsis of the Fishes of North America. By DAVID S. JORDAN and CHARLES H. GILBERT. Washington: Government Printing Office. 1883. [8<sup>o</sup>, lvi, 1018 pp.=Bull. U. S. Nat. Mus., No. 16.]

1885. The Standard Natural History. Edited by JOHN STERLING KINGSLEY. Vol. III. Lower Vertebrates, [etc.], Boston: S. E. Cassino and Company. 1885.

The authors of the ichthyological portion were S. W. Garman, Theodore Gill, D. S. Jordan, and J. S. Kingsley.