NOTES ON THE TETRAODONTOIDEA.

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(With Plate xxxiv.)

I.

After the completion of my "Note on the genus Chonerhinae or Xenopterus," it appeared to me to be desirable to review several other questions concerning other genera of Tetraodontoidea and the taxonomic values of the included forms.

All the Tetraodontoidea were included by Linnaeus in a single genus and are still so included by Günther. Gill proposed to differentiate them under three families. The gradations between those extremes are many.

II.

No deliberate attempt was made to subdivide Tetradon among genera till nearly four decades of the present century had elapsed. Swainson, in 1839, gave generic names to five sections under which Cuvier segregated the species.* Johannes Müller soon after proposed other generic names, some of which were anticipated by Swainson. Bleeker, Bibron, and Peters added other genera. Bibron especially had skeletons of many species prepared for a contemplated monograph of the group which he first recognized as a family, "Tetradonidae." These skeletons were utilized by Hollard in 1857 in Études sur les Gymnodontes, in which he recognized six genera on osteological characters, scientifically appreciated the relative values of their characters, and combined them in a tribe or subfamily. Blecker disregarded the osteological characters, and based the genera admitted by him on characters derived from the carination or planeness of the back, extent of the snout, form of nostrils, and dermal appendages. The next step was violently retrograde. Günther ignored all the excellent work done by Hollard, and reduced all the Tetraodontoidea to two genera combined with the Diodon.

* The genera proposed by Lacépède for two species, Spheroidea and Grajia, were due to unmitigated ignorance and strange blundering respecting their characters.

"Nares utroque latere foraminiformes in papilla concava plus minusve elevata perforata" in Tetradon; "Nares utroque latere tentaculum simplex vel duplex" [etc.] in Cryptacodon; "Nares utroque latere infundibuliformes imperforata" in Lepadon, Chonerhinae, and Ephippion.


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tide to constitute a single group of his family called Gymnodontes. He subsequently made another retrograde step and reverted to the Linnaean conception of the genus, combining all in one genus, Tetrodon.

Meanwhile the work of Hollard remained unknown or neglected. In 1884, Gill recognized this work, utilized his material for a systematic revision of the group, elevated the Linnaean and Güntherian genus Tetrodon (Tetraodon) to superfamily rank, and divided it into three families distinguished by osteological characters. In the framework thus reared, Jordan and Edwards, in 1887, intercalated all the species of American Tetraodontoidea, but degraded the group to family rank and the families to subfamilies.

Jordan and Edwards's memoir is excellent and the first one in which scientific principles were applied at the same time generally and in detail to the consideration of the group. The range of the genera, so far as the American species are concerned, appears to be natural and their nomenclature nearly correct. There are some questions involved, however, which merit reconsideration and I propose to now pass in review all the genera that appear to be well established.

III.

1758) TETRAODON. (Linnaeus.

Jordan and Edwards have reached the same conclusions as I formerly did respecting the application of the name Tetraodon, but by a different route. I should not have considered it necessary to discuss the question involved if a fallacy had not found way in their argument which might be repeated in various other cases. Under the circumstances, a review of their argument may be useful. I first give their own words:

The name Tetraodon first appears as a generic term, so far as known to us, in Hasselquist's Travels in Palestine, edited by Linnaeus, in 1757. We have not examined this work, but our impression is that it is binomial in form, and that the name Tetraodon is here associated only with Tetraodon fahaka, the Tetraodon lineatus of the Systema Naturae, and a member of the group called Arothron.

If this work of Hasselquist be taken in consideration, the name Tetraodon must be assigned to the present group.

But the conventional starting point of binomial nomenclature is later, and in the Systema Naturae, Linnaeus includes all the species of the present family known to him, in the genus Tetraodon.

We must then consider the later attempts at restriction of the group.

In 1839, Swainson made the first attempt at generic division.

Retaining the name Tetrodon for the bulk of the species (including our genera Spharoides and Tetraodon), he separated from it Lagocephalus, Leiodon (or Leisomus), Cirrhosomus, and Canthigaster (or Psilonotus).

The first and last of these were well defined. The others, Leiodon (based on the absence of prickles) and Cirrhosomus (based on the presence of ciioti), rested on characters of no systematic importance. Under the generic name of Tetrodon, four species are mentioned as types. Three of these belong to the Arothron group; the other is a Chelonodon. But none of them are Linnaean species, although one of them (testudi
The next subdivision seems to be that of Müller (1841), who retained the name of Tetraodon for none of his divisions.

Next (1855) we have the subdivision of Bibron. By him the group was divided into a large number of genera, part of them without definition and all of them with French names only. For one of his sections the name Tetraodon was retained. This group, as arranged by Bibron, included a single Linnean species as type. This one, lineatus, is a member of the group called by Müller Arotliron. This seems to be the first proper restriction of Tetraodon, and, so far as we can see, it must stand, making Tetraodon the equivalent of Arotliron.

Later, 1857, Holland worked over the material of Bibron, and adopted—an skeletal characters only—an arrangement of genera, not unlike that given in the present paper. His genera are Xenocephalus (not American), Rhynchotus (=Acanthogaster), Batrachops (=Colomesus), Brachycephyalus (=Tetraodon), Apsicophalus (=Spharoides and Lagacophalus), Monotreta (not American).

Holland supplies a Latin form to the French names of Bibron, and using the name Tetraodon as a general term, he places Bibron's Tetraodon as a subgenus under his own Brachycephyalus.

In 1867, Bleeker, probably regarding lineatus as the proper type of Tetraodon, seems to have suppressed the latter name as a synonym of the name Crayacion, used by Klein before the date of the Systema Naturae. Other ichthyologists do not give Klein's names precedence over those of Linneaus, and under the rules of nomenclature which we adopt, Crayacion must be disregarded.*

In 1873, Prof. Gill used the name Tetraodon as synonymous with Lagacophalus, and in 1885 as synonymous with Arotliron. In 1883, Jordan and Gilbert regarded T. testudinans as its type, thus making it synonymous with Spharoides.

It seems evident to us, from the above data, that it is best to regard Tetraodon lineatus as the type of Tetraodon, and thus make the latter name the equivalent of Arotliron.

The fallacy in this argument is in considering the name Tetraodon in the same light as a new generic name. Swainson did not pretend to enumerate all the species of the genus. He simply selected some, of which there existed figures in a couple of illustrated works accessible to himself. Inasmuch as those so selected were congeneric with Linnean species, those Linnean species were by implication included and actually do belong to the genus as limited by Swainson. Of course, if Swainson had given a new generic name, the name could only have been retained for species actually included by him under the genus named; as it was, he simply limited a genus already established, and the genus so limited included, by the terms of its diagnosis, two of the five original species of Tetraodon, while not more than one Linnean species belongs to any other genus.

I revert, with Jordan and Edwards, to the name Tetraodon for this

*Tetraodon and Crayacion were both used by Bleeker, the former being applied to the genus Lagacophalus and the latter being essentially equivalent to Arotliron of Müller, or Tetraodon of Jordan and Edwards and American authors.
The change of the name to *Tetrodon* by Linnaeus, Günther and other authors was unnecessary, inasmuch as the original form is sanctioned by classical usage, as in the case of *τετραοδία* and *τετραοδός* (quadrivium), *τετράρρυγος* (four fathoms in extent), *τετράρρυη* (four-horsed chariot), etc.

The genus appears to contain few species. Four have been referred to it by Bibron, (1) *T. lineatus* Lin.; (2) *T. patoca* Horn (Buchanan); (3) *T. dorso-unicolor* Bib.; and (4) *T. bouronensis* Bib. The last two have never been described, and it is not known what they are. The *T. patoca* has been referred to a distinct section of the genus by Dr. Günther. The absence of specimens in the National Museum prevents me from forming an opinion.

1798.) SPHEROIDES. (Lacépède) Duméril.

The nomenclature of this genus has been considered by Jordan and Edwards,* Jordan† alone, Gill,‡ and again by Jordan§ alone, and Bollman,|| and we have now no points of difference; all American authors who have expressed their sentiments¶ are of the same opinion. Reluctant as I am to adopt the name given under the conditions *Spheroides* was, there seems to be more possibility of agreement by so doing than by any other course.

A notice of *Anchisomus* has been overlooked. It occurs in remarks by Richardson on "*Anchisomus reticulatus* (Kaup)."

"The species of this genus mentioned in Dr. Kaup's list are *Anchisomus* Spengleri, angusticeps, multistriatus, reticulatus, scalaris, geometricus, and *turgidus*. *Anchisomus*, *Gastrophysus*, *Cheilichthys*, and *Leiosomus* form a group of *Tetrodontidae*, in which the nasal cavity is small and flat, with two nostrils."**

1839.) LAGOCEPHALUS. (Swainson.

The nomenclature of this genus is now clear, and therefore needs no consideration here.

1839.) CANTHIGASTER. (Swainson.

*Canthigaster* is now accepted by me in place of *Psilonotus*, formerly used. Richardson (in 1854)† and Bleeker (in 1859) employed *Psilonotus*, and in 1876 and 1884 I followed them in so doing. Jordan and Ed-

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† Jordan, < o. c., 1887, p. 481.  
‡ Gill, < o. c., 1888, pp. 667, 668.  
§ Jordan, < o. c., 1889, pp. 183, 651.  
|| Jordan and Bollman, < o. c., 1889, p. 183.  
¶ Gilbert, < o. c., 1890, p. 455. Evermann and Jenkins, < o. c., 1891, p. 165.  
** Zoöl. Voyage Herald, 1854, p. 162.  
†† Richardson described the typical *P. rostratus* as "*Prilonotus* (or *Anchisomus*) caudacinctus." *Prilonotus* was evidently a slip for *Psilonotus*.  

wards, however, have shown good reason for not doing so longer, and also reason not good. Their own words may be reproduced:

The proper name of the genus has been involved in some confusion, owing to the use by Swainson of two different names for it.

On page 191 of his miserable work on the classification of fishes, Swainson gives an analytical key to the genera, and applies to the present group the name of Canthigaster (correctly written Cænauthogaster). No species are here mentioned by Swainson, but in this case his diagnosis is accurate and sufficient. On page 328, these genera are again defined, the present one in nearly the same way, but under the name of Psilonotus. Two species (rostratus: electriicus) are here mentioned as types.

Professor Gill has preferred to adopt the last-mentioned name, regarding Canthigaster as unidentifiable except through the medium of the species mentioned under the diagnosis of Psilonotus. Dr. Bleeker has preferred to take the earlier name of Cænauthogaster. In this case it is certainly true that no doubt could exist as to what Swainson intended to include under Canthigaster, even had the second diagnosis been omitted; moreover, the name Psilonotus is preoccupied. We see, therefore, no sufficient reason for setting this name aside, objectionable as it is.

I can only account for Jordan and Edwards's assertion that Swainson's diagnosis of Canthigaster is "sufficient" by the surmise that they have considered the diagnosis of Psilonotus instead of Canthigaster. The sole diagnosis of Swainson's Canthigaster is in the words: "Canthigaster: Muzzle prolonged and narrow; belly with spines." Now, if Messrs. Jordan and Edwards consider this sufficient, I do not, and I find it as applicable to some species of "Sphyraenidae;" especially S. angusticeps, as to the species recently referred to Psilonotus. Indeed, the resemblance of S. angusticeps to the Psilonotus is so great as to have misled two incomparably better ichthyologists than Swainson—Richardson and Steinadlumer—who actually referred that species to the genus, the former calling it Anchisomus angusticeps and the latter Canthogaster lobatus.

Nevertheless, Jordan and Edwards were quite right in correcting me for adopting the name Psilonotus, but only because that name had been preoccupied in Hymenoptera, a fact of which I was not aware in 1884.

Under the circumstances, however, it may be doubtful what name to take up for the genus in question. Canthigaster, with its apparent etymology, is a very objectionable name, and its application, as already urged, could not have been certainly determined "except through the medium of the species mentioned under the name of Psilonotus." But as it can be so determined, I am disposed, after Bleeker, Jordan, and Edwards, and some others, to adopt it. It would naturally be supposed that the name was intended to allude to the spiniferous belly, and Swainson undoubtedly labored under the delusion that "cainthus"—or, "caunthus" was a good Greek derivative for spine.1 Swainson, however,

1The external difference between the species of Canthigaster are marked but they are not indicated by the words of Swainson.

1See Cauithophyes (vol. 1, p. 364; vol. 2, p. 319), Canthiopipes (vol. 2, pp. 7, 52, 179 261), Cenonanthes (vol. 2, pp. 176, 212), Polyzanthus (vol. 2, pp. 175, 242), etc. Another delusion was that leptes was a Greek derivative for scale or scaly.
did not actually give the etymology of his name and those who would be distressed by the form of the name may derive it from *Canthus*, one of the Argonauts, and *gaster*, belly, and assume it to refer to the ability to swell the belly* and thus float along. Bleeker attempted to correct the word to *Canthogaster* and used the name *Canthogastrini* as the designation of a "phalanx" in his system. Jordan and Edwards have preserved the form *Canthigaster* and used *Canthigasterinae* as a subfamily name. I propose also to retain the name *Canthigaster* and derive from it the family name *Canthigasteridae.*

1839. LEIODON. (Swainson.)

In 1839 Swainson introduced a new generic name with the following diagnosis:

*Leisomus* Sw.—Head short; the body entirely smooth.

*T. levisissimus*. Sch.†


On a previous page he had, in the same sequence under *Tetraodınae*, the following genus:

*Leidon.*—Head short; body entirely smooth.

No species was mentioned.

*Leisomus marmoratus* was a substitute for *T. cututia* of Hamilton. There is no "*T. levisissimus*" in Bloch and Schneider's "Systema Ichthyologiae," and Swainson has simply copied the name from the Règne Animal of Cuvier, who, in his second section of the genus *Tetraodon*, characterized by the entire body smooth, grouped two species: "*T. levisissimus* Bl., Schn."; and "*T. cututia*, Buchan, xiii, 3."

There is a Crayracion *levissimus* of Klein‡ (the *Spheroides maculatus*), and Cuvier may have, by slip of memory, substituted "Bl., Schn." for Klein. But, as it is, the first species of Swainson's genus is indeterminable and the merits of his genus (for practical purposes) must be determined by the only species identifiable. That species is typical of a good genus and, for a wonder, Swainson's diagnosis is applicable and almost distinctive, though the full force of it can only be appreciated by one who knows the crania of the genera *Tetraodontinae*.

In 1855 Bibron introduced a new generic name, *Monotrête*, for the *T.*

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*Unfortunately the species of the genus are less endowed with this capacity than the typical *Tetraodontidae.*

†According to Richardson (Zoöl. Herald, p. 162), "*Prilonotus* is a name invented by Müller, and is mentioned by him in his "Fortsetzung der Myxinodden," and the Archiv für Naturgeschichte für 1841, but I have not found his detailed account of the characters. Dr. Kaup enumerates the following species: *Pril. rostratus* Lin. (margaritatus Rüppell, solandri Richardson), *nillepunctatus*, *occipitalis*, *oculifer*, *insignitus*, *careulo-punctatus*, and *pictus.*" The appearance of the nasal depression is fully described as it appeared to Richardson. As already indicated, *Prilonotus* is a slip for the Swainsonian name *Psielonotus*, and does not occur in Müller's work.

cutentia, and the genus was subsequently well defined from cranial characters by Hollard, as Monotreta.

Bibron diagnosed a genus in the following terms:

8.° G. Monotreta, Bib. (nouvo, seul, epe tnet, troné, percé). "Naries n'ayant cha-
cune qu'une seule ouverture circulaire à bord non saillant. - Point d'épines sur auc-
cune partie du corps, qui est complètement lisse. - Nageoires imparées arrondies: epitére et hypoptère courtes."

Espèce unique: T. cutentia, Lam. (Buchanau).

In 1865 Bleeker united Monotreta with Leiodon, expressing the following opinion respecting Hollard's views:

Il fit un seul genre des Crayrâciom et des Leiodon, tout en conservant le genre Mono-
treta Bib, qui cependant ne diffère pas des Leiodon.

Bleeker adopted the genus Leiodon of Swainson rather than Leisomus or Liosomus or Liosoma, for the following reasons:

Le nom générique de Leisomus mériterait donc d'être conservé s'il n'avait pas été
employé, avant Swainson, en 1831, pour un genre de Calóptères. Or, Swainson dans
son Natural History of Fishes, etc., employa aussi (p. 194), pour indiquer son genre
Leisomus, le nom de Leiodon, et c'est par conséquent ce nom, qu'il aurait du du reste
crître Leiodon, qui a le droit de priorité sur celui de Joh. Müller.

I can not corroborate the statement that Leisomus or Liosomus or
Liosoma had been employed in zoology before its use by Swainson,
although Leisoma and Liosoma had been frequently used. While I
for myself should have preferred the name Liosomus, I acknowledge
Bleeker's right to choose one of two names simultaneously given, and
consequently accept Leiodon, as that name does not appear to have been
previously used, either in that form or under the guise of Liodon.

In 1870 Günther accepted the name, under the modified form Mono-
tretus, for a section of Tetrodon, including only the T. cutentia, with
the following diagnosis:


The other species of Leiodon noticed by Bleeker were referred to an
other section, viz:

C. A simple, not perforated nasal cavity with a fringed edge. Body spiny: Chel-
onodon (Mül).

The genus thus appears to have been based on decided external as
well as cranial characteristics and is therefore adopted.

The history of the genus is summarized in the synonymy.

Leiodon.

= Monotretus Günther, Cali. Fishes, B. M., v. 3, pp. 272, 330, 1870 (Section of Tetrodon).
Tetrodon sp., Hamilton et al.
Leiodon sp., Bleeker (1865).
This name has been already considered in my article on *Chonerhinus* and therefore needs no further discussion here. It is very desirable, however, that a renewed examination of proper material should be undertaken to solve the doubtful questions that still exist.

1841.) *AROTHRON.* (J. Müller.

In 1839 Johannes Müller, in his "Vergleichende Anatomie der Myxinoiden," (published in 1841,*) gave new generic names to several types of Tetraodontids, *Physogaster, Chelonodon, Cheilichthys,* and *Arothron,* presenting the following diagnosis of the last:

Noch andere, wie *Tetrodon testudinarius*1 haben statt der Nasen jederscits ganz solide Tentakeln, in welche der starke Gernuchsvoige geht. Diese haben auch einen Ringmuskel um das Auge und eine Art Angenieder, die Untergattung *Arothron.*

Coordinée with the ring muscle is the deflection of the postfrontals, and especially the prefrontals, to describe the segment of a circle.

In 1855 a diagnosis of a genus was published in the following terms:


This genus has been confounded by Jordan and Edwards, as well as others with *Tetraodon,* but it differs decidedly in osteological characters, and has been associated with the Bibrionian genera *Aphansaeanthus,* *Amblyrhynchotus,* *Stenometopus,* *Genvion,* *Epipederhynchus,* and *Promecoecephalus* in a comprehensive group, to which a new generic name, *Apsicephalus,* was given by Hollard, while the typical *Tetraodon* was united with *Dichotomyceter* in another supergeneric group called *Brachycepalus* by Hollard.

*Arothron,* being the prior name and based on the typical species of *Dilobomycter,* should be adopted.

1854.) *CHONERHINUS.* (Bloeker.

The facts respecting this genus have already been detailed in a previous article on the genus and therefore need not be repeated here.

1 *Tetrodon testudinarius* (see Archiv für Naturg., 9. Jahrg., p. 330, 1843) is the *Tetrodon reticularis* Schu. (See Gthr. Cat. fishes, v, 8, p. 326.)
In 1855 A. Duméril published from the MSS. of Bibron the following diagnosis of a genus of *Tetrodonididae*.

4° G. Amblyrhynchote, Bib. (εἰμιτῆς, obtus, πυς, museum). "Narines ayant la forme d'un tube court, clos au sommet, mais percé latéralement de deux ouvertures opposées. Museun obtus, un peu déclive.—Épiphite et hypophite pointus, opposées l'un à l'autre."


The National Museum has skeletons of *T. Honckenii* and *T. oblongus*, and also of *T. pardalis* (Temm. and Sch.), and these indicate a genus distinct from *Lagocephalus* to which they would be generally referred on account of agreement in the nasal structure. But further they indicate that there is considerable difference between *T. oblongus* and *T. pardalis* on the one hand and *T. Honckenii* on the other. I reserve the consideration of these differences and the nomenclature for a future occasion.

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In 1855 Bibron's name *Ephippion* was published with the following diagnosis:

9° *G. Ephippion*, Bib. (Εφιππίων, selle). "Narines en cupule profonde; de ses bords s'élevent trois tentacules aplatés, dont un est plus large, mais moins long que les autres.—Des épines au ventre; tête et queue lisses; dos et flancs revêtus d'une enaiisse de même nature que celle qui enveloppe la totalité du corps des Cobres.—Épiphite et hypophite pointus, courtes; uroptère à rayons externes plus longs que les autres."

Espèce unique: *E. maculatum*, Bib.

The *E. maculatum* was not described.

In 1865 Bleeker, in a review of Bibron's system, concluded that *Ephippion* was the only genus with which Bibron enriched science and gave the following note on *E. maculatum*:


In 1870, Günther recognized in the genus "*Tetrodon*" a section based on the *Tetrodon guttifer* of Bennett, to which he gave the new name *Hemiconeiatus*. The section was defined in the following terms:

1. The dermal ossifications are in the form of spines and of scutes, the latter forming a continuous carapace round the trunk. *Hemiconeiatus*.

The notices of Bibron and Bleeker of *Ephippion* were completely overlooked and ignored in the synonymy of the species, section, and genus *Tetrodon*. *Hemiconeiatus* is in fact a synonym of *Ephippion*, and in order to learn the essential characters of *T. guttifer*, such as the
structure of the nostrils, the number of fin rays, and the color, recourse must be had to the previous notices of the *E. maculatum* of Bibron and Bleeker.*

The synonymy of this form will then be as follows:

**Ephippion.**


=Ephippion *Bleeker,* Atlas Ich. Néerland. Ind., v. 5, pp. 47 (also printed *Ephippium*), 49, 1865.

=Hemiciconius *Günther,* Cat. Fishes, B. M., v. 8, p. 272, 1870.

The type *E. guttifer* (=*Tetrodon guttifer* B.) is the only known species, and is confined to the northwest and west African coast.

*Ephippium* was apparently a mere slip for *Ephippion.* *Ephippium* had been twice used before 1854—by Bolten in 1798 for a genus of mollusks, and by Latreille in 1802 for a genus of dipterous insects. *Ephippion* had not been previously used, is sufficiently distinct from *Ephippium,* and has classical sanction, as in *logarion.*

1854.) **COLOMESUS.** (Gill.

This genus was instituted in 1855 by Bibron and well diagnosed and illustrated in 1857 by Hollard. Its establishment therefore dates from 1855, but unhappily a name previously used in ichthyology (*Batrachops*) was taken by those excellent naturalists. In 1884 I was therefore obliged to give a new name. As the nomenclature is now clear, no further remarks are necessary.

Only one species is known, the *C. psittacus,* found in the northern streams of South America.

It is noteworthy that the first use of the name *Tetraodon* in ichthyology (so far as I know) occurs in connection with the type of this genus, which was called *Ostracion tetraodon* in Seba's work.

**OTHER GENERA.**

Such are the genera that appear to have undisputed claims for recognition in a scientific arrangement of the *Tetraodontoida.* There is reason to believe, however, that among the genera named by Bibron there may be several others that require admission into the system. The "new species" named by that naturalist have never yet been described. More than a generation has passed away since they were announced, and it certainly is not to the credit of French ichthyologists that they have never been determined. We might reasonably have expected that two learned ichthyologists (Hollard and Bleeker), who have examined the collection, would have determined them. Hollard left his meri-

*Dr. Günther can not be blamed, however, for not having given such information, as his specimen (20 inches long) was "stuffed," and anyone who has to do with stuffed gymnodonts will acquit him of blame, since he tried to find the characters, as indicated by his queries as to the "nostrils?" and the number of dorsal rays, "nine-rayed. (?)"
torious work incomplete in that he did not do so, and must accordingly be especially blamed therefor. It may be hoped that the accomplished naturalist now in charge of the collection (Prof. Leon Vaillant) will soon have the work done, or, still better, do it himself.

IV. SYSTEMATIC RELATIONS.

In 1884 I expressed the hope that naturalists might "make use of their reasoning powers in considering [the three families of Tetraodontoidea then recognized] and not assume that they are unjustifiable because previous students had not appreciated their value." The hope, however, has not yet been realized. President Jordan, from whose vigorous and progressive intellect most might have been anticipated, reduced the families to subfamily rank, and thus reverted to my system of 1878. A few remarks seem to be called for in defense and support of my later views.

Such families as the Percidae, Serranidae, Pristipomatidae, Sparidae, and Squamipinnae, with varying limits, are recognized by almost all ichthyologists of the present time. Now what are the differences between them, compared with those between the three families into which the Tetraodontoideans have been distributed? They depend, as generally defined, on slight differences in the dentition, armature of the opercular bones, and extension of the scales on fins. Even if we look into the internal structure, no very salient differences are observable; we become, from such an examination, convinced that the characters that have been generally used to differentiate the families are almost worthless as expressions of real affinities, but there is a striking general resemblance in the crania and in all other parts. Contrast with such characters the differences exhibited by the crania of representatives of the three families of Tetraodontoidea. The difficulty is, then, not to ascertain the differences, but to appreciate the resemblances. Many anatomists would fail at first glance to understand the comparative homologies of the bones exhibited by the several types of Tetraodontoideans if they commenced their examination without any previous information. And yet, forsooth, the families of Acanthopterigian fishes are generally admitted, while one eminent ichthyologist unites all the Tetraodontoideans in a single genus! Could inconsistency go farther?

The differences between one of these tetraodontoidean families (Chonerasidae) and the others extend to the vertebral column in a marked degree; most have a greatly diminished number of vertebrae; therefore the order, to accommodate them, has been said to have "the vertebrae in small number;"* the Chonerasidae have more vertebrae than a large proportion of the acanthopterygian fishes and certainly do not

* Günther, Int. Study Fishes, p. 683, 1880.
have them "in small number." Various families of acaulopterygians have been distinguished on account of the numbers of vertebrae; the Carangids, for example, have been distinguished because they have "ten abdominal and fourteen caudal vertebrae." Fishes closely allied in other respects to the Carangids have been excluded because they have twenty five* or more vertebrae.†

Let it be borne in mind that the differences in the number of vertebrae are not coördinated in the special cases of the acaulopterygians had in mind, with any other modifications. Yet an eminent ichthyologist unites the Tetraodontids and Cauhtigasterids having "the vertebrae in small number" (less than "ten abdominal and fourteen caudal vertebrae") with the Chonerhiniids having the vertebrae in increased number ("more than ten abdominal and more than fourteen caudal vertebrae") in one and the same genus, although those differences are coördinate with numerous other structural modifications.

It is because President Jordan has probably been influenced by the treatment of the group under review by an eminent authority, and not allowed his own excellent and candid judgment to have full sway, that I feel constrained to comment on the inconsistency and want of scientific method involved in the examples in question. Far from fearing that I have gone too far in subdivision of the Tetraodontoideans, I feel that I have scarcely gone far enough. I should perhaps raise the Colomesines to family rank, and if I do not so do it is because I am desirous to appear not to go to an extreme. The recognition of the family value of the Colomesine group may be left to another or to some other time. Perhaps Mr. Boulenger, the learned herpetologist of the British Museum, may so elevate it.

That distinguished and really scientific herpetologist has employed a character, analogous to the principal one which distinguishes the Colomesines from the bulk of the Tetraodontids, to diagnose several families of lacertilians.‡ The Colomesines have the "postfrontals" so elongated and extended forwards as to unite with the "prefrontals" and thereby exclude the narrowed frontals from the orbits, while the Tetraodontines have wide frontals entering into the roofs of the orbits. Three families of lizards are distinguished chiefly on account

* Many true Carangids have twenty-five or other than twenty-four vertebrae.
† The strict accuracy and absence of exaggeration of the statements here made may be inferred from facts. Dr. Günther, in his Catalogue of Fishes, referred Naucrates to the Scymnidae because it had Vert. 10–16 (p. 374), and referred Seriola (p. 462) and Nucilurus (p. 469) to the Carangidae because they were supposed to have Vert. 10–14. Soon afterwards I demonstrated that two of the nominal species of Seriola and the six nominal species of Naucrates were based on different stages of the youth of Naucrates and that probably all belonged to a single species. The correctness of this statement has long been universally accepted—even by Dr. Günther—and the genus Naucrates is now retained by all in the Carangidæ next to Seriola, where I placed it. (See Proc. Acad. of Nat. Sc. Phila., 1862.)
‡ See Boulenger, Cat. Lizards B. M., v. 1, pp. 1, 2.
of analogous extensions of the postfrontals and prefrontals* and thereby
the contraction of the frontals to the middle of the cranium—the Pyg-

opodida;† the Anniellida‡ and Helodermatida.§

V.

In conclusion I submit the revised synonymy and definition of the
superfamily Tetraodontioidea and diagnoses of the three families. They
are essentially the same as those published in 1884.

I add copies of the illustrations of the crania of the six genera of Tet-

raodontioidea published by Hollard. Those who may think I have gone
too far in estimating the values of the groups so figured may judge
from an attempt to recognize the homologies of the bones, how distant
some of them are from each other. If they ought all to be combined in
one genus, surely there should be no difficulty in recognizing the bones
at once.

TETRAODONTIOIDEA.

Synonym as superfamily name

<Tetradontioidea Gill, Cat. Fishes E. Coast N. A., p. 6, 1 873.

Synonym as family names.

ΟΟστόδερμας Donvier, Zoöl. Anal., p. 109, 1396.
ΟΟγυμνοδόντες Latrelle Jour. Nat. Réque An., p. 115, 1825.§

* It is not meant, by the use of the words prefrontals and postfrontals, to imply that the
bones so called in fishes are the same as those of the same name in reptiles.
Indeed, there appear to be few (and possibly no) bones precisely homologous in reptiles
and fishes, homology (in the word of Ray Lankester) prevailing rather than homol-
ogy. But the homonymous bones cover corresponding regions and there is ap-
parently no reason why their modifications are not of approximately equal value in the
two cases.

† The Pygopodida have "the pre- and postfrontals in contact, separating the
frontal from the orbit." (B., o. c., v. 1, p. 229). "The structure of the skull is most
similar to that of Geckos, but differs in two points: (1) the separation of the frontal
from the orbit by the union of the pre- and postfrontal, a character which is
shared by Heloderma; (2) the reduction of the number of bones in the mandible, in
which respect they resemble the snakes." (B., o. c., p. 231.)

‡ The Anniellida are said to have the "pre- and postorbital in contact, separating the
frontal from the border of the orbit." (B., o. c., v. 2, p. 209.)

§ The Helodermatida have the "pre- and postfrontals in contact, separating the
frontal from the orbit." (B., o. c., v. 2, p. 301.)

ΟΟοστοδίας = γυμνοδόντες + οστρακοδέρματυ.


<Gymnodontes Günther, Cat. Fish. B. M., v. 8, p. 269, 1870.>


<Tetradontidae Gill, Arrangement Fam. of Fishes, p. 1, 1872.


**Synonymy as subfamily names.**

<Odopsia Rafinesque, Anal. de la Nat., p. 89, 1815.>

×Orbidia Rafinesque, Anal. de la Nat., p. 89, 1815.


<Tetradontinae, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 194, 325, 1839.


<Tetradontina, Günther, Cat. Fishes Brit. Mus., v. 8, pp. 269, 270, 1870.


**Diagnosis.**

Gymnodontes without either pelvis or ribs;† with a normally developed caudal region,§ with the internaxillary and dentary bones severally connected by suture at middle, the supramaxillaries curved outwards behind the internaxillaries, the ethmoid more or less projecting in front of the frontals, and the postfrontals extended outwards as far at least as the frontals.\

**Synopsis of families.**

1. Vertebrae numerus, i. e., 12–17 pm. ........................................... Chonerhinidæ.
2. Vertebrae few, i. e., 7–8+8–13.
   a. Medifrontines separated from the supraoccipitine by the postfrontals meeting in the middle .......................................................... Cantigasteridæ.
   b. Medifrontines articulated with the supraoccipitine and the postfrontals confined to the sides ................................................. Tetradontidæ.

**TETRAODONTIDÆ.**

**Diagnosis.**

Tetradontoidea with the medifontines articulated with the supraoccipitine and the spenotics (postfrontals) confined to the sides, the pros-

* Odopsia=Gymnodontes.
† Orbidia=Orbidus (=Spheroides) +Oonidus (=Ovoide Lac.)
† The Triodontoidæ have ribs.
§ The Molitoidæ have an aborted and excessively modified posterior region.
|| The Diadontoidæ are distinguished by the union of the jaw bones of the opposite sides, and great modifications of the cranium.
ethmoid little prominent to view above and short or narrow, the vertebrae in small number (7, 8+9—13), the head (typically) wide and with a heavy wide snout, and the dorsal and anal fins short and panniculate.

**CANTHIGASTERIDÆ.**

*Diagnosis.*

Tetraodontoidea with the medifrontines separated from the supraoccipitine by the intervention of the sphenotics, which are connected together and laterally expanded but short, the prosethmoid prominent above, enlarged and narrowed forwards, the vertebrae in normal number (about 8+9), the head compressed and with a projecting attenuated snout, and the dorsal and anal fins short and panniculate.

**CHONERHINIDÆ.**

*Diagnosis.*

Tetraodontoidea with the medifrontines separated from the supraoccipitine by the intervention of the sphenotics (postfrontals), which are much enlarged and assume a quadrangular form, the prosethmoid little prominent to view and very short, the vertebrae in increased number (12+17), the head wide and with a blunt wide snout, and the dorsal and anal fins long and multiradiate (D 32-38; A 28-32).

V.

The genera of *Tetraodontoidea* certainly very much needs revision, and many species yet require to be referred to their proper systematic places. The paucity of the material in the National Museum prevents my undertaking the task at present. Mr. Barton Bean, the assistant curator of fishes, to whom I am indebted for efforts to bring together the material, has only been enabled to find thirty-three species. There are skeletons of twelve species, viz.:

**TETRAODONTIDÆ.**

**TETRAODONTIDÆ.**

1. *Spheroides maculatus* = *Tetraodon hispidus* var. *maculatus* Schm.
2. *Spheroides testudineus* = *Tetraodon testudineus* Linn. = *Stomomatus testudineus* Bib.
3. *Spheroides politus* = *Tetraodon politus* Girard.
4. *Amblyrhynchotus pardalis* = *Tetraodon pardalis*, T. & S.
5. *Amblyrhynchotus oblongus* = *Tetraodon oblongus* Black = *Amblyrhynchotus oblongus* Bib.
6. *Amblyrhynchotus Honckenii* = *Tetraodon Honckenii* Black = *Amblyrhynchotus Honckenii* Bib.
7. *Lagocephalus levigatus* = *Tetraodon levigatus* L. = *Promecophalus levigatus* Bib.
8. *Lagocephalus lunaris* = *Tetraodon lunaris* Schm.
10. *Arothron hispidus* = *Tetraodon hispidus* Bl. = *Dilobomycterus hispidus* Bib.

**COLOMESINÆ.**

**CANTHIGASTERIDÆ.**


My knowledge of the cranial characters of Chonerhmis is derived solely from the description and figures of Hollard. There is only one specimen of C. naritus in alcohol in the National Museum.

Any additional material will be welcomed and equivalents given in exchanges by the National Museum.

The value of the skeleton, even for specific distinctions, is well illustrated in the case of S. testudineus and S. politus. Messrs. Jordan and Edwards record the S. politus as a "doubtful species," probably the adult form of S. testudineus.* They also state that the old specimens of T. politus "differ from S. testudineus (annulatus) only, so far as we can see, in the absence of prickles," † and consequently "see little reason to doubt that Spheroïdes politus is simply the adult of S. testudineus annulatus."

The National Museum has skeletons of S. testudineus and S. politus of nearly the same length, and the differences between the crania of the two is very marked, the former having the interorbital area comparatively narrow, and the prefrontal grooves narrow, while the latter has the interorbital area very broad and the prefrontal grooves shallow and wider ‡

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† Proc. U. S. Nat. Mus., v. 9, p. 239.
‡ Profs. Evermann and Barton have reached the same conclusion respecting S. politus and S. testudineus and have remarked that "the interorbital space is flat" in S. politus and "concave in S. testudineus annulatus." (Proc. U. S. Nat. Mus., v. 14, p. 165, 1891.) No one, however, has noticed the difference in the width of the interorbital space. It will be interesting to compare the anatomy of S. testudineus (typical) and S. testudineus annulatus.
The illustrations of crania are reproduced from those of Howard's memoir.