

A STUDY OF THE TRUNK-FISHES (OSTRACIONTIDÆ), WITH NOTES
UPON THE AMERICAN SPECIES OF THE FAMILY.

By G. BROWN GOODE.

The fishes of the order *Plectognathi* have afforded a knotty problem to writers on systematic ichthyology. Many genera have been established, and, between them, the several species have been buffeted to and fro until their synonymy is tangled like a spider's web. The following historical sketch of the progress of opinion in the classification of the Ostracionts was drawn up as an aid in determining what generic names should be used for the common West Indian forms.

Artedi and Linnæus were acquainted only with those which have the carapace closed behind the anal fin, now included by Günther in the subgenus *Ostracion*. The first of the other type, with carapace open behind the anal fin, was described by Houttuyn in 1782,* and again by Thunberg, under another name, eight years subsequently.† Schneider, Shaw, Lacépède, and their contemporaries recognized only the old genus, and it was not until 1838 that Dr. Gray separated certain species under the name *Aracana*.‡

Lacépède was the first to propose a division of the genus *Ostracion*, though he did not advocate the use of names for his subgenera, nor indeed propose any. His divisions were based upon the arrangement of the spines on the carapace, as given below. He knew no representatives of the *Aracana* type.

FIRST SUBGENUS.

No spines before the eyes nor under the tail.

1. L'OSTRACION TRIANGULAIRE (= *O. triquetus*).
2. L'OSTRACION MAILLÉ (= *O. triquetus*).
3. L'OSTRACION POINTILLÉ (= *O. punctatus*).
4. L'OSTRACION QUATRE-TUBERCULES (affinities unknown).
5. L'OSTRACION MUSEAU-ALLONGÉ (= *O. cubicus*).
6. L'OSTRACION DEUX-TUBERCULES (= *O. cubicus*).
7. L'OSTRACION MOUCHETÉ (= *O. cubicus*).
8. L'OSTRACION BOSSU (= *O. nasus*).

SECOND SUBGENUS.

Spines in front of the eyes but none under the tail.

9. L'OSTRACION TROIS-AIGUILLONS (mythical?).

*1782. HOUTTUYN, M. Beschrijving van Eenige Japansche Visschen en andere Zeeschepselen. < Verhand. d. Holland. Maatsch. Wetenschappen, Haarlem, xx, 2, 1782, pp. 311-350. *Ostracion aculeatus*, p. 346.

†1790. THUNBERG, C. P. Beskrifning på tvänne fiskar inifrån Japan <. Vetenskaps Acad. Nya. Handl. xi, 1790, p. 106 +. *Ostracion hexagonus*, p. 107.

‡1838. GRAY, J. E. < Ann. Nat. Hist. 1, p. 110.

THIRD SUBGENUS.

Spines under the tail but none in front of the eyes.

10. L'OSTRACION TRIGONE (= *O. trigonus*).
 11. L'OSTRACION DOUBLE-AIGUILLON (= *O. bicaudalis*).

FOURTH SUBGENUS.

Spines in front of the eyes and under the tail.

12. L'OSTRACION QUATRE-AIGUILLONS (= *O. quadricornis*).
 13. L'OSTRACION LISTER (= *O. quadricornis*).
 14. L'OSTRACION QUADRANGULAIRE (= *O. cornutum*).
 15. L'OSTRACION DROMADAIRE (= *O. turritus*).

The next attempt at a subdivision was by Swainson in 1839,* and was based entirely upon the shape of the carapace. The peculiar features of this arrangement can most easily be shown by quoting in full from the preliminary synopsis (p. 194).

I. Sub-family OSTRACINÆ. Body mailed with angular plates.

OSTRACION. *Body quadrangular, destitute of spines.

TETROSOMUS. Body quadrangular; spines on the back and belly.

*Body triangular.

Platycanthus. Body with several flattened bony obtuse spines.

Lactophrys. Front and vent with two horn-like, acute spines.

Rhincosomus. Body without spines, often scored as in the *Balistinae*.

In the main body of the "Classification of Fishes, etc." (pp. 323-324), the definitions of genera and subgenera were expanded as follows:

I. Sub-fam. OSTRACINÆ.

Body smooth, quadrangular in the typical and triangular in the aberrant groups, covered by angulated bony plates, soldered at their sutures; dorsal fin one; no ventral fin; caudal rounded.

OSTRACION, Linn. Body quadrangular; destitute of spinal processes.

O. cubicus, Bloch. pl. 137. *nasus*, Ib. pl. 138.

TETROSOMUS, Sw. Body quadrangular; armed with spines on the back and belly.

T. turritus, Bl. pl. 136.

Lactophrys, Sw. (fig. 102). Body triangular, armed with strong spines, curved backward just before the anal fin, and generally with two others, resembling horns.

L. trigonus, Bl. pl. 135.

cornutum, Bl. 133.

bicaudalis, Ib. 132.

quadricornis, Ib. 134.

Rhincosomus, Sw. Body triangular, entirely destitute of spines, and often scored or reticulated as in *Balistes*.

R. triquet, Bloch. pl. 130. *concatenatus*, Ib. pl. 131.

Platycanthus, Sw. (*Acarana*, Gray). Compressed, subtriangular, with broad obtuse plates or spines scattered over the body and eyes.

P. auratus, Shaw. Nat. Miss. pl. 338.

It would be interesting to know what relations are indicated by the different kinds of type employed by the author. But for the direct

* 1839. SWAINSON, WILLIAM. The Natural History | of | Fishes, Amphibians, and Reptiles | or | Monocardian Animals. | By William Swainson, F. R. S., F. L. S., &c., &c. | ——— | in two volumes. | ——— | Vol. I (II). (Vignette.) | London: | Printed for Longman, Orme, Brown, Green, and Longmans, Paternoster Row, | and John Taylor, Upper Gower St., | 1839. Vol. ii, pp. 193, 323.

statement of a quadrangular character for *Tetrosomus* it would appear certain that the three following divisions were intended as subgenera, subordinated to *Tetrosomus*. As it is, it seems to be more than probable that an omission was made by the author, and that the diagnosis should read "triangular or quadrangular;" for the species chosen as type of *Tetrosomus* is in fact pentagonal. This, however, would throw out *Rhinosomus* and certain species in *Lactophrys*. Be this as it may, we have no right to guess at the real meaning of the author; these divisions are treated as genera in every particular except that their names are in italics instead of capitals, and as genera they must be quoted, charging discrepancies to the account of carelessness and bad workmanship.

In 1855 the group underwent another revision at the hands of Dr. Kaup.* Besides forming several new subgenera for the *Acarana*-like forms he made a complete redistribution of the species among the genera. Regarding the triangular species as types of the genus *Ostracion* of Linnaeus he proposed a new generic name, *Cibotion*, for *Ostracion* as limited by Swainson, and in this group placed *O. tuberculatus*, *O. cubicus*, *O. punctatus*, *O. argus*, *O. cyanurus*, and *O. Sebac*. In "*Lactophrys*, Swains. (part)," he placed *O. cornutus*, *O. fornasini*, and *O. diaphanus*, all species with spinous, four-ridged carapaces, while in "*Ostracion*, Lim. (part), Kaup," which he regarded as equivalent to *Rhinosomus* and *Tetrosomus*, Swains., he placed all the triangular species, which he divided into five sections: "a. Without long spines over the eyes and on the edges of the body"—*O. triquetus*. "b. With spines near the anal fin"—*O. bicaudalis*, *O. trigonus*, and *O. oriceps* (= *O. trigonus*). "c. With spines over the eyes and on the edge of the carapace"—*O. quadricornis*. "d. With 2-3 short spines on the elevated dorsal ridge, short spines over the eye and upon the edges of the very broad carapace, diminishing with age to weak points"—*O. concatenatus*. "e. With strongly quadrangular body and much elevated back, provided with a strong spine; spines over the eyes and on the lower edges of the carapace."—*O. gibbosus*.

In the following year a fresh revision was undertaken by Prof. H. Hollard, of the Faculty of Sciences at Poitiers,† who reassembled in the one genus, *Ostracion*, all the species with a post-abdominal bridge to the carapace, retaining for the others the name *Acarana*, Gray. In this usage he is followed by Dr. Bleeker in his later publication, though he freely admits that earlier in his career as an ichthyologist, impressed like his predecessors by the diversified forms of the known species of *Ostracionts*, he was inclined to believe that many genera could be distinguished among them. "But," he continues, "in searching for characters which should define them satisfactorily, I discovered that I could

* Op. cit., pp. 214-221.

†1853. HOLLARD, H. Monographie de la Famille des Ostracionides. <Annales des Sciences Naturelles, 4^e ser. Zool. vii, 1857, pp. 121-170.

find none." Bleeker admits three genera, *Ostracion*, *Aracana*, and *Centaurus*, the latter founded on a grotesque form known to ichthyologists only from a drawing of a very young individual made by Dr. Hooker. *Ostracion* is divided by Bleeker into subgenera as follows:

Ostracion, Art. = *Tetrosomus*, Swms. = *Rhinesomus*, Swms. = *Lactophrys*, Swms. = *Cibotium*, Kp.

Pyxis postice integra basin pinnae dorsalis et analis includens, medio inferne plana non carinata. Pinna dorsalis. Pinna caudalis radiis 10 (1 | 8 | 1). Spec. typ. *Ostracion tetragonus*, L.

Subgenus *Ostracion*, Art. Pyxis tetragona, trigona vel pentagona, anacantha. Spec. typ. *Ostracion tetragonus*, L.

Subgenus *Lactophrys*, Swms. Pyxis trigona vel pentagona, utroque latere carina ventrali postice spina armata. Sp. typ. *Ostracion trigonus*, L.

Subgenus *Tetrosomus*, Swms. Pyxis trigona vel pentagona orbitis, crista dorsali mediana carinisque ventralibus acanthophora, spinis orbitalibus sursum nec antorsum directis, ventralibus pluribus. Spec. typ. *Ostracion turritus*, Forsk.

Subgenus *Acanthostracion*, Blkr. Pyxis trigona, pentagona, vel tetragona orbita carinaque ventrali postice acanthophora, spinis orbitalibus antorsum directis. Spec. typ. *Ostracion quadricornis*, L.*

These divisions correspond very closely to those of Lacépède already referred to; *Ostracion* being equivalent to section 1, *Lactophrys* to section 3, while section 4 is about equally divided between *Tetrosomus* and *Acanthostracion*.

Dr. Günther,† like Hollard and Bleeker, considers the typical *Ostracions* to be embraced within the limits of one natural genus, and even includes those with carapace open behind the anal fin. Such, at least, is his course in the generic diagnosis of *Ostracion*, though he actually adopts the name *Aracana* as if it represented a true genus, and enumerates the species under a separate series of numbers.

In arranging the species of *Ostracion* he adheres rather to the method of Swainson than of Lacépède, considering the shape of the carapace to be the most convenient basis of classification. His divisions are as follows:

- I. Carapace three ridged.
- II. Carapace four or five ridged, without spines.
- III. Carapace four ridged with spines.

The third division corresponds exactly to Swainson's *Tetrosomus*, if his diagnosis be accepted without change, the second division to Swainson's *Ostracion* and Kaup's *Cibotium*, the first division to the three last subgenera (?) of Swainson, which he probably meant to subordinate to a third genus which he neglected to name.

The usage of American authors has been various. Storer, although he described his Holmes' Hole specimen under the name *Ostracion Yalei*, accepted in his "Synopsis" the names *Rhinesomus triquetus* and *Lactophrys scæcornis*.

* Atlas ichthyologique, v, 1805, pp. 27-28.

† Catalogue of the Fishes in the British Museum, viii, 1870, p. 256.

Professor Gill, in 1873, catalogued the east coast species as *Lactophrys trigonus*.*

Poey, in his "Synopsis Piscium Cubensium,"† follows the lead of Bleeker, accepting his subgenera though not bracketing them into the middle of the binomial names as was the practice of the Dutch zoologist. In a later work, the "Enumeratio Piscium Cubensium," he adopts the genera *Ostracion*, *Acanthostracion*, and *Lactophrys*. Jordan uses the name *Lactophrys quadricornis*, accepting provisionally Swainson's arrangement.

After studying the group, as represented in the collections of the National Museum, I am unable to recognize any characters sufficiently persistent to serve in dividing the typical *Ostracions* into genera. The most dissimilar forms are connected by others, intermediate in character, and a series of specimens in various stages of growth of a single species like *O. quadricornis* or *O. concatenatus* shows great age-variation both in shape of carapace and in size and distribution of spines.

As has been remarked, Lacépède and Bleeker regarded the position of the spines as the most reliable character for classification.

Hollard sums up his observations on the specimens in the Paris Museum as follows:

"The diversity of species at a first glance appears greater than it is in reality; at least it is easy to reduce them to a small number of typical forms. The true types are those based upon form. *The absence, the presence*, and the number of the spines, large or small, with which many of the *Ostracionts* are provided, afford characters of very secondary and simply specific value. These spines in fact are present or absent without regard to more important characters. * * * They should be subordinated to other differences between which no known examples form connecting links."‡

Kaup and Swainson, on the other hand, adopted the form of the carapace as the most important character. This was considered by Hollard as of but little value for generic diagnosis, and by Bleeker is disposed of most summarily. "The triangular or quadrangular form of the body," he remarks, "appears to have no real value (for the separation of genera) since it depends simply upon the greater or less convexity or elevation of the dorsal plane of the carapace. If, for example, we place an *Ostracion triqueter*, L., by the side of an *Ostracion tetragonus*, L. (= *O. cubicus*), we have before us two well-marked types, one with a triangular the other with a quadrangular carapace (*Ostracion*, Kaup, and *Cibotia*, Kaup). But if between these two extremes we place an *Ostracion guineensis*, Blkr., and an *Ostracion nasus*, Bl., we cannot decide whether we are dealing with a triangular or quadrangular form, for the dorsal surface is elevated in the shape of a roof, presenting two faces which descend from a central crest to unite at an obtuse angle with the

* Rep. U. S. Com. Fisheries, part i, p. 793.

† Repertorio Físico-Natural de Isla de Cuba, ii, 1868, pp. 439-442.

‡ Annales des Sciences Naturelles, vii, p. 140.

lateral walls of the carapace. It is evident, from the study of these transitions, that the form of the carapace cannot furnish a certain basis for the establishment of distinct genera.

“The character of the spines has, however, a greater value than that of the form of the carapace. Although it be true that spines do not occur exclusively upon this or that form of carapace, since there are triangular trunk-fishes without spines, others armed with frontal and anal spines, and others with anal spines alone, while there are also quadrangular ones, spineless, or armed on the forehead and beneath the tail, still there may be observed a certain consistency in their arrangement as regards their position, their form, their number, and their direction. But this constancy does not extend to their persistency since some spines, or indeed all of them, are absorbed and disappear entirely in adult individuals of certain species. In this manner all the spines disappear with age in *Ostracion concatenatus*, and if one were disposed to see generic characters in its arming, three genera might be founded upon *Ostracion stellifer*, Bl., Schn. (in which the forehead, the dorsal keel, and the ventral ridge are spinous), *Ostracion bicuspis*, Blum., figured by A. Smith (which has only dorsal and ventral spines), and *Ostracion concatenatus*, Bl. (which has the carapace entirely spineless). In reality these species are merely nominal; *Ostracion stellatus* and *Ostracion bicuspis* being young individuals of the species of which *O. concatenatus* is the adult. In one other species, *Ostracion cornutus*, Linn. (not Bloch), the spines in the middle of the lateral dorsal ridge, and those on the ventral ridge, decrease with age, and in the adult finally disappear. In other species the spines are much more constant, but their proportions, very different in accordance with the age of the individual, render it sufficiently evident that they afford a character of very doubtful value. I should, however, note the fact that there is no known example of an *Ostracion* with horizontal frontal and anal spines in which these spines disappear in adult age.”

As has already been stated, the subgenera adopted by Bleeker are founded solely upon the number and position of the spines. In *Tetrosomus* he places one pentagonal species, but in *Acanthostracion* and *Ostracion* he includes triangular, tetragonal, and pentagonal forms without discrimination. Notwithstanding the strong grounds taken by him in regard to the importance of the shape of the carapace it seems to afford the most reliable guide in an arrangement of the species of this genus. An arrangement with reference to the position of the spines produces some incongruous results, while the other plan harmonizes to a great extent with all structural features as well as with the geographical distribution of the group. Hollard remarked that the serial gradation of the species was of great interest, but he did not work it out with the care which might have been expected. I have endeavored to indicate what seems to me to be a natural series, from the triangular spineless form through the pentagonal form, provided with many spines, to the tetragonal spineless form at the other extreme.

Serial arrangement of the species of Ostracion.

- I. Form triangular, spineless *O. triquetter*.
- II. Form triangular, with two ventral spines..... *O. trigonus*, *O. bicaudalis*.
- III. *a.* Form triangular, with two ventral and two horizontal frontal spines, the posterior extension of whose base gives in young individuals a semblance to a tetragonal, in adults to a pentagonal shape..... *O. quadricornis*.
- b.* Like the last in every respect except that there is a median dorsal spine. (This is frequently seen in the young of *O. quadricornis*, disappearing at different stages of growth in different individuals, but in others persistent)..... *O. quadricornis*, subspecies *notacanthus*.
- IV. *a.* Form subtriangular, approaching to pentagonal, the posterior extension of the orbital crest being more pronounced than in III. Frontal spines small, vertical, frequently double, two small spines upon the dorsal ridge and two on each ventral keel, all the spines obsolescent with age.... *O. concatenatus*.
- b.* (A side-shoot from *a.*) Like the last, but with all characters exaggerated and more persistent, the dorsal spine single and high, the spines on each lateral keel four in number.
O. turritus (by Günther considered to be probably identical with *O. concatenatus*).
- V. *a.* Form subtetragonal, approaching pentagonal, but with a dorsal surface clearly defined, though the affinity to the triangular forms is indicated by a pronounced elevation of the dorsum, surmounted by a high spine. Frontal spines horizontal, stronger. The fullness of the anterior part of the body observed in the forms already studied is suggested by a bulging of the ventral surface *O. Fornasini*, *O. cornutus*, Linn. = *O. diaphanus*, Schn.
In *O. diaphanus* the dorsal surface is flatter than in *O. Fornasini*, but there are small spines on the dorsal and ventral keels, obsolescent in age, which suggest the preceding form. The two forms together, or an average between them, form a needed link in the series.
- b.* (A side-shoot with great development of frontal and ventral spines.) Forms similar to the last but approximating still more closely to the tetragonal, particularly in adult age; without dorsal spine, though with a trace of its presence in an elevated dorsal ridge. Horizontal spines very prominent.
O. arcus, Schn. = *O. cornutus*, Bloch.
- VI. Form tetragonal, spineless, similar to the last, but with squarer angles. "A more or less sharp protuberance in front of the dorsal fin, from which several pointed lines radiate." Horizontal spines absent. This is the transition from the subpentagonal and subtetragonal to the truly tetragonal forms.
O. ornatus.
- VII. *a.* Form tetragonal, spineless, similar to the last, but with lower though still very distinct dorsal ridge. A trace of rostral prominence..... *O. natus*.
- b.* (Side-shoot from *a.*) Similar to *a.*, but with prominent rostral hump.
O. rhinorhynchus.
- c.* Form truly tetragonal, back convex, not ridged, dorsal and ventral keels blunt..... *O. cubicus*, *O. punctatus*, *O. sebca*.
- VIII. Form tetragonal, spineless, back flat, ridges sharp..... *O. Renardi*, *O. solorensis*.

Such is the continuity of the gradation in this series that it is almost impossible to distribute the species into subgenera, though the extreme forms would be considered by many writers as belonging to well-marked genera were the intermediate forms not known. The transition is perfect, without a break from *O. triquetter* to *O. Renardi* and *O. solorensis*. Even the size, abundance, and distribution of the spines are seen to be correlated to the shape of the body, for these are to be regarded, as

was suggested by Hollard, merely as exaggerations of the crests and ridges which define the lateral, dorsal, and ventral surfaces of the carapace, occurring in those parts of the body and in that part of the above series where these crests and ridges are most emphasized, and their absence coinciding with the absence of prominent lines of demarcation. They are most numerous in the middle portion of the above series, in the forms transitional between the triangular and tetragonal sections of the genus, and are alike also at both extremes.

The geographical distribution of the species is interesting in the light of this gradation. The triangular forms (I and II) occur only in the West Indies. The next in order (III) occur not only in the West Indies but in the southeastern Atlantic. The subtriangular form (IV) is represented in the southeastern Atlantic (at the Cape of Good Hope), in the western Pacific (China), in Australia and the East Indian Archipelago. The subtetragonal forms (V) are represented in the Indian Ocean, west to the Cape of Good Hope, in Japan and Australia, and in the East Indian Archipelago, while the tetragonal forms (VI, VII, and VIII) almost exclusively in the Indian Archipelago and the Indian Ocean.

There is no dearth of names for the sections of this group, but as has been remarked, it is impossible to assign them or subdivide the genus by any but arbitrary methods.

Swainson's *Ostracion* corresponds to Divisions VI, VII, and VIII; his *Tetrosomus* to Divisions IV and V, although he assigns *O. cornutus* to the following genus; his *Lactophrys* to Divisions II and III, and his *Rhinosomus* to Division I.

Kaup's *Ostracion* would include Divisions I, II, III, and IV; his *Lactophrys*, Division V; and his *Cibotium*, Divisions VI, VII, and VIII. Bleeker's *Ostracion* includes I, VI, VII, and VIII; his *Tetrosomus*, IV; his *Acanthostracion*, II, III, and V.

Dr. Bleeker by assuming Division V, instead of Division I, as one extreme of the series, made his division of the group into subgenera more plausible. This arrangement does not, however, allow as complete a gradation of form.

SUBORDER OSTRACODERMI,* GILL.

Synonym as family name.

- < *Sclerodermes*, CUVIER, Règne Animal. 1st ed ii, 1817, p. 153; 2d. ed. ii, 1829, p. 375.
- < *Sclerodermi*, GÜNTHER, Cat. Fish. Brit. Mus. viii, 1870, p. 207. (Synonym as subordinal name.)
- < *Sclerodermes*, HOLLARD, Ann. Sci. Nat. (4) xiii, 1860, p. 31.

Synonyms as ordinal names.

- < *Sclerodermi*, BONAPARTE, Giorn. Accad. di Scienze, lii, 1832 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 39). •

*The synonymy of this suborder is in substance quoted from GILL. MS.

- = *Ostraciones*, BLEEKER, Enum. Sp. Pisc. Archip. Indico, xiv, 1859, Atlas Ichthyologique, v, 1865, p. 25.
 = *Ostracodermi*, GILL, Arrangement of the Families of the Fishes, 1872 (November), pp. xii, i.
 = *Cataphracti*, FITZINGER, Sitzungsber. k. Akad. Wiss. (Wien), lxxvii, Abth. 1, 1873, p. 47.

FAMILY OSTRACIONTIDÆ.

- Ostracidi*, RAFINESQUE, Indice d'Ittiolog. Siciliana, 1810, p. 39 (Gill).
Ostracidia, RAFINESQUE, Analyse de la Nature, 1815 (as subfamily, *vide* Gill).
 Subfam. *Ostracina*, SWAINSON, Nat. Hist. Fish. Amphib. and Rept. 1839, ii, pp. 194, 323.
Ostraciontini, BONAPARTE, Nuovi Annali d. Sci. Nat. ii, 1838, p. 131; iv, 1840, p. 186 (as subfamily, *vide* Gill); NARDO, l. c. inf. p. 71.
Ostraciontida, NARDO, Atti Congressi Scienz. Ital. rac. et ord. i (1842), 1844, p. 70 (Gill).
Ostraciones, BLEEKER, Bijdrage; Balist. en Ostraciones van den Ind. Archip. 1852, pp. 28-36.
 (Family) *Ostraciontida*, GILL, Arrangement of the Families of Fishes, 1872, p. 1.
 (Family) *Ostracionida*, KAUP, Archiv für Naturgeschichte, 1855, pp. 215-221.
 Famille des *Ostracionides*, HOLLARD, Annales des Sciences Naturelles, vii, 1856, pp. 121-170, pl. xiii.
 Familia *Ostracionoidei*, BLEEKER, "Enum. sp. Pisc. Archipel. Ind. xiv, 1859;" Atlas Ichthyologique, v, 1865, pp. 24-42, ppl. cci-civ.
 Group *Ostraciontina*, GÜNTHER, Catalogue of the Fishes in the British Museum, viii, 1870, pp. 255-268.
Ostraciida, COPE, Proc. Amer. Assoc. Adv. Sci. xx, 1872, p. 340; GOODE, Cat. Fish Bermudas, 1876, p. 53 (name only); GILL, Bibliog. Fish Pacific Coast (unpublished).
Ostraciontes, FITZINGER, l. c. sup.

DIAGNOSIS OF FAMILY.

Plectognath fishes with short, angular bodies, covered by a modified integument consisting of numerous closely juxtaposed polygonal osseous plates. Caudal peduncle, bases of fins, and snout covered with flexible skin. Maxillary and intermaxillary bones anchylosed. A single row of short teeth in each jaw. A single dorsal fin opposite the anal; no ventrals. Vertebrae 14, the first 9 elongate. No ribs.

SYNOPSIS OF GENERA.

- Carapace forming a continuous bridge behind anal fin, ventral surface acarinate, caudal with 10 rays OSTRACION (Art.) Linn.
 Carapace open behind anal fin, ventral surface carinate, caudal with 11 rays or more. ARACANA, Gray.

GENUS OSTRACION.

- > *Ostracion*, ARTEDI, Gen. Pisc. 1738, p. 55.
 = *Ostraciones polyodontes*, ARTEDI, l. c.
 = *Ostracion*, LINNÆUS, Syst. Nat. ed. x, 1758, 1, p. 330; ed. xii, 1766, p. 407.
Les Ostracions, LACÉPÈDE.
Les Coffres (*Ostracion L.*), CUVIER, Règne Animal. ed. 1, 1817, p. 154; ed. ii, 1829, p. 375.
Ostracion, GRAY, Annal. Nat. Hist. 1, 1838, p. 110.
Ostracion + *Tetrosomus* + *Lactophrys* + *Rhinesomus*, SWAINSON, Nat. Hist. Fish. Amphib. and Rept. 1839, ii, pp. 193-194, 323-324.
Ostracion, BLEEKER, Verhandelingen van het Bataviasch Genootschap van Kunsten en Wetenschappen, xxiv, 1852, Bijdrage tot de Kennis der Balistini en Ostraciones van den Indische Archipel. p. 28; Atlas Ichthyologique, v, 1865, pp. 25-42.

*Carapace tetragonal*₂.

(Carapace with ventral and frontal spines.....O. ARCUS, L.)

NOTES ON AMERICAN SPECIES.

OSTRACION TRIQUETER, Linn.

Ostracion triqueter, LINNÆUS, Syst. Nat. ed. x, 1758, 1, p. 330, No. 1, ed. xii, 1766, 1, p. 407.—BLOCH, Ichthyologie, iv, 1787, p. 106, taf. cxxx.—GMELIN, Linn. Syst. Nat. i, 1788, p. 1441.—LACÉPÈDE, Hist. Nat. Poiss. etc., i, 1798, p. 444; ed. ii, 1819, ii, p. 331, pl. xiv, fig. i.—SCHNEIDER, Bloch, Syst. Ichth. 1801, p. 498.—SHAW, Gen. Zool. v, 1804, p. 420.—CUVIER, Règne Animal, ed. i, 1817, p. 154; ed. ii, 1829, ii, p. 376, note.—MÜLLER & GROSCHEL in Schomburgk's Hist. Barbados, 1848, p. 677.—KAUP, Arch. für Naturg. 1855, p. 217.—HOLLARD, Ann. Sci. Nat. vii, 1856, p. 154.—BLEEKER, Atl. Ichth. v, 1865, p. 26.—GÜNTHER, Cat. Fish Brit. Mus. viii, 1870, p. 256.

Ostracion triquetrum, POEY, Mem. Sob. Hist. Nat. Cuba, ii, 1861, p. 361; Rep. Fis. Nat. Cuba, ii, 1868, p. 442; Enum. Pisc. Cubens. 1876, p. 176.

Ostracium triquetrum, COPE, Trans. Am. Phil. Soc. 1870, p. 475.—GOODE, Cat. Fish Bermudas, 1876, p. 23; Amer. Journ. Sci. and Arts, 1877 (Oct.), p. 290.

Rhincosomus triqueter, SWAINSON, Nat. Hist. Fish. Rept. and Amphib. 1839, ii, p. 323.

Piscis triangularis ex toto cornibus carens, LISTER in App. Willughby Hist. Pisc. 1686, p. 20.—RAY, Syn. Method. Pisc. p. 45, No. 9.

Ostracion triangulus, tuberculis exiguis innumeris, aculeis carens, ARTEDI, Gen. Pisc. 1738, p. 57, No. 10; Syn. Pisc. 1738, p. 85, No. 14.

Ostracion polyodon incermis triqueter, LINNÆUS, Mus. Adolphi Frederici, i, 1754, p. 60.

L'Ostracion maille, LACÉPÈDE, l. c.

Cuckold, Bermudas.

Chapin, Cuba.

Drunken-fish, Trunk fish, Plate-fish, or Fair Maid, Barbados.

DISTRIBUTION.

Bermudas (Goode).	Tortugas (National Museum).
Jamaica (Günther).	Trinidad (Günther).
Cayenne (Günther).	Barbados (Schomburgk).
Cuba (Poey).	St. Croix (Cope).
Gulf of Mexico (Hollard).	Mexico (Hollard).
Bahia (Castelnau).	Brazil (Cope).
St. Martins (Cope).	Vera Cruz (Cope).

Ostracions with triangular carapace, without spines. Height slightly greater than half the length of the body without the caudal, breadth equal to half the length of the body in adults, greater in young. Ventral surface of carapace convex anteriorly, concave posteriorly. Back elevated compressed, sides joining at an angle of about thirty degrees. Carapace continuous behind dorsal fin. Head contained three times in length of body. Interorbital space concave. Upper surface of snout concave. Diameter of eye contained eight to nine times in total length, four to four and one-half in height of side.

Teeth long, spike-like, eight to ten in upper jaw; eight to ten in lower jaw.

Scales of the sides hexagonal, in young with striae radiating from

centre to angles of each scale, in adult armed simply with tubercles, nine to ten, in longitudinal series from gill-opening to tail, eight in median line of ventral surface, eight between ventral keel and angle of back. Posterior dorsal scute unarmed.

Branchial aperture oblique, its length greater than the diameter of the eye, descending before the base of the pectoral. Fins obtusely rounded. Pectoral equaling in length. Caudal of moderate length and rounded.

Radial formula D. 10, A. 10, P. 12.

Color: The color of living individuals is thus recorded in my Bermuda note-book:—"Dark-brown, thickly studded with circular spots of yellowish white, each about two lines in diameter; the position of these spots appears to have no relation to the shape of the plates of the carapace. Ventral surface lighter and spotless. The epidermis is often abraded leaving the shell uniform tawny-white. The lips, bases of the fins, and tail-stem are brown like the ground color of the body." In dried specimens the epidermis dries and loses its color, and the shell shows through with a lighter shade. Günther states that the lips, roots of the fins, root of the tail, and tip of the caudal are black. This I have not observed.

The largest individuals seen by me measured about 265 millimetres in length, but these were quite unusual in size.

The Cuckold is common throughout the West Indies, and has been found south to Bahia, while, to the north, it is carried by the Gulf Stream as far as the Bermudas. Its limits of distribution are more closely restricted to the Caribbean Sea and the neighboring waters than those of any other species in the genus.

It is recorded that the crew of Columbus, on their first voyage, in 1492, while at anchor on the coast of Cuba, captured a fish which "was like a swine, all covered with a very hard skin, no part whereof was soft but the tail," which was probably one of the Ostracions.

Little can be said in reference to its habits, except that it is sluggish and lives close to the bottom, where it probably feeds upon hydroids ascidians, and other soft-bodied animals. This is somewhat conjectural for no one has ever taken the pains to examine the stomach contents of any member of the genus, but it is not very hazardous to make this surmise, for the sluggish movements of the Trunk-fish would not permit it to pursue active living prey, while its small, weak teeth are thoroughly unsuitable for feeding upon shells and barnacles.

The method of locomotion in this and other members of the genus Ostracion is very peculiar. When in Bermuda, in 1872, I had two of them for a time in my aquarium, and had an excellent opportunity of observing the movements of their fins.

The rigid shell prevents any flexure of the body, the only parts with power of independent motion being the lips, the dorsal and anal fins, and the stem of the tail. These protrude through openings in the cara-

pace, and the bases of the fins as well as the lips are encased in tough skin, leathery and flexible. Even the gill-openings are incapable of independent motion, for they are only straight, narrow, vertical slits in the carapace just in front of the pectoral fins.

The sinuous muscular movement of the posterior half or two-thirds of the body, which plays so important a part in the movement of the ordinary fish, is of course impossible, and the rotary, sculling motion so noticeable in the caudal fin of a fish, like a minnow or a trout, seems equally unknown. The power of propulsion appears to be vested chiefly in the dorsal and anal fins. These are broad and round, provided apparently with strong muscles, and the anal is placed almost directly beneath the dorsal. When the fish moves it is solely by the effect of a strong, slow, regular half-rotary movement of these two vertical fins, much resembling that of the screw-wheel of a propeller-engine. The caudal fin is kept vertical, and, moved from side to side, plays the part of a rudder, except when needed for an unusually rapid movement, and then it adds its strength with long, strenuous side-strokes. There are no ventral fins, nor do they seem to be needed, for the fish is balanced upon its centre of gravity and well under the control of its propulsive fins. The pectorals probably perform a certain part in balancing, but seem to be most useful in keeping up a circulating current through the gill-apertures.

Their movements are sluggish, and they do not seem to require a rapid aeration of the blood, for I have known them to live for two or three hours out of water, and when restored seem none the worse for the change of element, save that for a time they were prevented from sinking to the bottom by the air which they had swallowed and which kept them awkwardly suspended at the surface.

I have rarely seen them swimming among the reefs. They appear to spend most of the time resting on the bottom, on the broad nether surface of the carapace. They never take the hook, but often enter the fish-pots set at a depth of two to ten fathoms.

No one has been so fortunate as to observe the breeding habits of the Ostracions; even the time of spawning is unknown.

In the Bermudas they are sometimes eaten, though not held in high estimation. I was unable to learn that evil effects ever follow their use for food at this locality. Hollard states that its flesh is said to be palatable and wholesome, but cites no authority for this observation, which is probably taken second-hand from Lacépède, who gives an enthusiastic eulogy of its good qualities. "Its flesh," wrote the fluent Gaul, "is more sought after than that of almost any other fish in the seas of America where it makes its home." And then he continued with a most amusing proposition for acclimating the species in the waters of France, and which is a good example of the theories of the would-be fish-culturists of eighty years ago. "Although it appears to thrive only in tropical regions we might endeavor to acclimate it in

waters more remote from the equator, since the differences of temperature presented by the water at different degrees of latitude are far less marked than those of the atmosphere. On the one hand we know with what facility fishes found only in the sea can be habituated to life in fresh water. The exquisite flavor and exceedingly wholesome nature of the flesh of the 'triangulaire' should encourage us to make persevering and well considered experiments in this direction; we might accomplish this acclimation, which would be important from more than one point of view, by gradual steps; we should gradually accustom the species to temperatures successively less warm; we should even continue the experiment through many generations of the animal before abandoning it completely, without artificial protection, to the climate in which it is to be naturalized. We should do for the 'triangulaire' what has been done for many species of plants; we should bring individuals of this species, and we should care for them through a long period in water, which we should keep at a temperature closely resembling that of the equatorial seas in their surface strata: then we should lower the temperature of the little pools in which the 'triangulaires' are kept by almost insensible degrees and by very gentle variations. In the regions of Europe and other parts of the globe, far removed from the tropics, where the thermal currents flow, we might at least profit by these naturally heated waters to give to the triangulaires that degree of heat which is to them absolutely necessary, or to accustom them by insensible degrees to enduring the ordinary temperature of the fresh waters or of the seas of those various regions."—(Lacépède, l. c.)

OSTRACION BICAUDALIS, Linn.

- Ostracion bicaudalis*, LINNÆUS, Syst. Nat. ed. x, 1758, i, p. 330, No. 3; ed. xii, i, 1766, p. 408.—BLOCH, Ichthyologie, iv, 1787, p. 109, p. cxxxii.—GMELIN, Linn. Syst. Nat. i, 1788, p. 1441.—LACÉPÈDE, Hist. Nat. Poiss. etc., i, 1798, pp. 465-466; ed. ii, 1819, pp. 342-343.—SCHNEIDER, Bloch, Syst. Ichth. 1801, p. 499.—SHAW, CUVIER, Règne Animal, ed. i, p. 154; ed. ii, 1829, ii, p. 375.—KAUP, Archiv für Naturg. 1855, p. 217.—HOLLARD, Ann. Sci. Nat. vii, 1856, p. 153.—POEY, Rep. Fis. Nat. Cuba, ii, 1868, p. 442.—GÜNTHER, Cat. Fish Brit. Mus. viii, 1870, p. 257.
- Ostracion bicaudale*, POEY, Mem. sob. Hist. Nat. Cuba, vi, 1861, p. 362.
- Ostracium bicaudale*, COPE, Proc. Amer. Phil. Soc. 1870, p. 474 (St. Martins).
- Lactophrys bicaudalis*, SWAINSON, Nat. Hist. Fish, Rept. and Amphib. 1839, ii, p. 323.—POEY, Enum. Pisc. Cubens. 1876, p. 176.
- Piscis triangularis, parvus non nisi imo ventre cornutus*, LISTER, in App. Willughby Hist. Pisc. 1686, xiv, p. 20.—RAY, Syn. Method. Pisc. 1713, p. 45.
- Piscis mediocris triangularis, ad imum ventrem prope caudam tantum cornutus*, etc., LISTER, l. c. p. 20.—RAY, l. c. p. 45.
- Ostracion triangulatus, tuberculis hexagonis radiatis, aculeis duobus in imo ventre*, ARTEDI, Gen. Pisc. 1738, p. 57, No. 9; Syn. Pisc. p. 85, No. 13.
- Ostracion triangulatus totius maculosus ac tuberculosus, aculeis duobus in imo ventre*, ARTEDI, Gen. Pisc. p. 57, No. 8; Syn. Pisc. 85, No. 12.
- Chapino, PAERA. *Trunk-fish*, Jamaica
Chapin, Cuba.

DISTRIBUTION.

Jamaica (Günther).	Barbados (Schomburgk).
Antilles (Hollard).	Jamaica (National Museum).
St. Martins (Cope).	Belize, Honduras (Günther).
Cuba (Poey).	Island of Ascension (Günther).

Ostracions with triangular carapace and with flat prominent spine on each ventral ridge. Breadth of body less than half its length without caudal.

Space between eyes concave. From the median dorsal line the sides of the back descend rapidly, curving outward slightly. Caudal fin rounded.

Color yellowish, with numerous small round brown spots on carapace, tail, and caudal fin. D. 10, A. 10, P. 12.

The Brown-spotted Trunk-fish has a wider distribution to the south than the Cuckold, having been recorded by Dr. Günther from the Island of Ascension, where a young individual was taken by Mr. J. Robinson. It is also in Mr. Osbert Salvin's Honduras collections. It has not yet been recorded from the coast of Florida, or to the north of Cuba.

It attains a much larger size than the preceding. Hollard gives the following dimensions for one of the largest in the Museum d'Histoire Naturelle:

	M.
Length	0.440
Maximum height	0.143
Length of head	0.090
Tail-stem	0.080
Caudal	0.080
Breadth of abdomen	0.110

The Trunk-fishes appear to have been objects of curiosity in the early days of American exploration, and were evidently among the choicest treasures of the primitive museums of the seventeenth and eighteenth centuries. Their strange shapes naturally attracted the attention of travellers, and then, as now, the ease with which their shells could be preserved made them favorites of curiosity hunters. No group of tropical fishes is so thoroughly worked out in the writings of "the fathers" as the Plectogonids, and none more so than the Ostracions. Over two hundred years ago every species of *Ostracion* now known from the western Atlantic had been named and described by the naturalists of northern Europe, and it is a well-deserved tribute to their discrimination as zoologists to say that none of the many efforts which have since been made to subdivide these species have been at all successful.

Artedi in his notes upon the different forms of *Ostracion* mentions the various collections in which he observed specimens. The "Naggs' head," "White Bear," and the "Green Dragon in Stepney," to which he very often alludes, seem to have been London taverns where curiosities were kept. He also speaks of seeing them in the museum of Hans Sloane, the nucleus of the British Museum; also in the collections of D.

Seba, in Amsterdam, of Mr. Lillja, in London, of Mr. (Don) Salteros, in Chelsey, and of seeing various specimens at Stratford, and "in spring-garden." No other kinds of fishes appear to have been preserved except "the monk- or Angel-fish *Anglis, aliis Mermaid-fish*," probably a species of *Squatina*, which he saw in London at the Naggshhead and in the town of Chelsey. The art of taxidermy was evidently not thoroughly established in 1738.

Of *Ostracion bicaudalis*, he remarks, "Vidi Londini, in the White Bear," and "Apud D^m Sebam vidi." *Ostracion trigonus* he saw "Apud Sir Hans Sloane et in Naggshhead"; *Ostracion triqueter* and *O. quadricornis*, "Londini in the Naggshhead et apud Mr. Lillia."

The specimens were all said to have come from India.

OSTRACION TRIGONUS, Linn.

Ostracion trigonus, LINNÆUS, Syst. Nat. ed. x, 1758, i, p. 330, No. 2: ed. xii, 1766, i, p. 408.—BLOCH, Ichthyologie, iv, 1787, p. 115, pl. cxxxv (*coffre à perles*).—GMELIN, Linn. Syst. Nat. 1788, i, p. 1441 (assigning erroneously 14 rays to first dorsal).—LACÉPÈDE, Hist. Nat. Poiss., etc. i, 1798, pp. 465-466; ed. ii, 1819, p. 842.—SCHNEIDER, Bloch Syst. Ichth. 1801, p. 499 (erroneously described with orbital spines).—SHAW, Gen. Zool. v, 1804, p. 422.—CUVIER, Règne Anim. ed. 1, 1817, p. 154: ed. ii, 1829, p. 375, note.—KAUP, Arch. für Naturg. 1855, p. 218 (a quoted name: Kaup did not profess to have examples).—HOLLARD, Ann. Sci. Nat. vii, 1856, p. 150.—GÜNTHER, Cat. Fish Brit. Mus. viii, 1870, p. 256.

Ostracion trigonum, POEY, Mem. sob. Hist. Nat. Cuba, ii, 1861, p. 362.

Lactophrys trigonus, SWAINSON, Nat. Hist. Fish, Rept. and Amphib. 1839, ii, p. 324, fig. 102.—POEY, Enum. Pisc. Cubens. 1876, p. 174.

Ostracion Yulci, STORER, Bost. Journ. Nat. Hist. i, 1837, p. 353, pl. viii.

Lactophrys Yulci, DEKAY, Zool. N. Y. Fishes, 1842, p. 362.—STORER, Mem. Am. Acad. Sci. viii, 1861, p. 429, pl. xxxv, fig. 3; Hist. Fish Mass. 1867, p. 429, pl. xxv, fig. 3.

Lactophrys oriceps, KAUP, l. c.

Ostracion (Lactophrys) undulatus, POEY, Rep. Fis. Nat. Cuba, ii, 1868, p. 441 (a specific name founded solely on color).

Lactophrys undulatus, POEY, Enum. Pisc. Cubens. 1876, p. 176.

Ostracion expansum, COPE, Trans. Amer. Phil. Soc. 1870, p. 474, figs. 9, 10.

Piscis triangularis clusii, cornibus carvens, LISTER, in App. Willughby, Hist. Pisc. 1686, p. 156.—RAY, Syn. Method. Pisc. 1713, p. 44.

Ostracion triangulatus, limbis figurarum hexagonarum eminentibus, aculeis duobus in imo ventre, ARTEDI, Gen. Pisc. 1738, p. 56, No. 7.

Ostracion triangulatus, limbis figurarum hexagonam eminentibus, aculeis duobus in imo ventre, ARTEDI, Syn. Pisc. 1738, p. 85, No. 11.

Ostracion polyodon tetragonus, abdomine pone bicorni, LINNÆUS, Iter Scand. p. 160.

Species dubia an Lactophrys trigonus? POEY, Rep. Fis. Nat. Cuba, ii, 1868, p. 441.

Chapin, PARRA, Desc. Dif. Piez. Hist. Nat. Cuba, 1787, p. 31, pl. xvii, fig. i, vide POEY, Proc. Acad. Nat. Sci. Phila. 1863, p. 183.

L'Ostracion triangulo-tuberculé, BONNATERRE, Encyc. Method. 1788, p. 21, pl. xiii.

Chapin, Cuba. *Trunk-fish*, Jamaica.

DISTRIBUTION.

St. Croix (Günther).

Jamaica (Günther).

Bermuda (Goode).

Cuba (Poey, National Museum).

Holmes Hole, Mass. (Storer).

Chesapeake Bay, October, 1877 (Lugger).

Barbados (Schomburgk).

St. Martins (Cope).

Tortugas (National Museum).

Bahia (Günther).

Bahamas (National Museum).

Ostracions, with triangular carapace, provided with a flat, conspicuous spine on each abdominal ridge, which is itself sharp and prominent.

Hollard claims that *Ostracion trigonus* is one of the largest, if not the largest, as was claimed by Artedi,* of the triangular species, and gives the following measurements of one of the specimens studied by him:

	M.
Total length	0.460
Greatest height.....	0.150
Greatest width (in abdominal region).....	0.135
Length of cephalic region	0.180
Length of tail-stem	0.100
Caudal	0.060
Largest diameter of lateral scutes.....	0.028

The largest specimen obtained by me in the Bermudas did not exceed 350 millimetres in length.

Linnaeus in his *Systema Naturæ*, edition tenth, attributed to this species fourteen dorsal rays, an error which, as Hollard has pointed out, has been copied and recopied by ichthyological writers down to the present day.

Kaup (l. c.) described the species anew under the name *Ostracion oviceps*. He appears not to have recognized any of the specimens studied by him as belonging to *O. trigonus*, the characters of which were totally misapprehended by him. His description of *O. oviceps* corresponds to the characters of *O. trigonus*,† while the radial formula, the only characters given by him for *O. trigonus*, are imaginary and do not apply to any fish known to exist. The formula for the dorsal perpetuates the Linnaean error already referred to; that for the caudal was probably made out from mutilated specimens. Hollard, who worked over the collections in the Paris Museum the year subsequent to the publication of Kaup's Memoir, states that he found certain specimens of *O. trigonus* which had been labeled with the name *O. oviceps* by Dr. Kaup, while others precisely like them had been left with the identification *O. trigonus*. This signifies little, however, for no good characters have ever been given for the proposed new species.

The color of living individuals of *Ostracion trigonus* is a uniform brown, with numerous irregularly grouped whitish spots, more abundant on the caudal stem than elsewhere. The fins are lighter than the body. Young specimens have a subcircular blackish blotch upon the side behind the gill-opening.

This species probably breeds in the Bermudas. I obtained three specimens ranging in length from 1 inch to 12 inches, though I was not so fortunate as to secure young of any other species of the genus.

* "Maximus est ex triangulatis," ARTEDI, Gen. Pisc. p. 57.

† Profil des Kopfes convex und plötzlich herabsteigend. Der lange Schwanz blau gefleckt oder einfarbig mit einem Hornschild auf der Wurzel nächst dem Panzer. Der Rücken hinter den erhöhten Augenkreisen begumend- Schwanzflosse gegabelt:

Trigonus, P. 10, D. 14, A. 9, C. 7. *

Oviceps, P. 12, D. 10, A. 10, C. 10. Kaup, l. c.

Lacépède and Hollard speak of the power of making audible sounds attributed to this species by travellers, and which had gained for it the name *cochon de mer*. I have never had one of them in captivity, but have often observed the same habit in *Ostracion triquetrum*, which utters frequent and audible grunting sounds when taken from the water. These sounds are similar to those made by several members of the family Tetodontidae, familiar to every collector of fishes on the Atlantic coast of the United States.

OSTRACION QUADRICORNIS, Linnæus.

- Ostracion quadricornis*, LINN. Syst. Nat. ed. x, 1758, i, p. 331; ed. xii, 1766, i, p. 408.—BLOCH, Ansl. Fische Ichth. iv, 1787, p. 113, pl. cxxxiv.—GMELIN, Linn. Syst. Nat. 1788, i, p. 1442.—LACÉPÈDE, op. cit. i, 1798, pp. 442, 468; ed. ii, 1819, ii, p. 343, pl. xv, fig. 2.—SCHNEIDER, Bloch Syst. Ichth. 1801, p. 499.—SHAW, Gen. Zool. v, 1804, p. 424.—CUVIER, Règne Animal, ed. i, 1817, p. 154; ed. ii, 1829, p. 375.—KAUP, Arch. für Naturg. xxi, 1855, p. 218.—HOLLARD, Ann. Sci. Nat. 1857, p. 148.—BLEEKER, Poiss. Guinée, 1863, p. 20.—GÜNTHER, Cat. Fish Brit. Mus. viii, 1870, p. 258.
- Ostracion quadricorne*, POEY, Mem. Hist. Nat. Cuba, ii, 1861, p. 362.
- Ostracion quadricorne*, COPE, Trans. Amer. Phil. Soc. 1870, p. 474.—GOODE, Cat. Fish Bermudas, 1876, p. 24; Amer. Journ. Sci. and Arts, 1877, p. 290.
- Ostracion (Acanthostracion) quadricornis*, BLEEKER, Atlas Ichthyologique, 1865, p. 32.
- Ostracion (Acanthostracion) quadricorne*, POEY, Rep. Fis. Nat. Cuba, ii, 1868, p. 439.
- Acanthostracion quadricorne*, POEY, Enum. Pisc. Cubensium, 1876, p. 174.
- Lactophrys quadricornis*, SWAINSON, Hist. Nat. Fish and Rept. 1839, ii, p. 324.
- Ostracion tricornis*, LINN. fide Bleeker, Ned. Tyds. Dierk. ii, p. 298.—LACÉPÈDE, op. cit. i, 1798, p. 435; ed. ii, 1819, ii, p. 342, pl. xv, fig. 1.
- Ostracion Listeri*, LACÉPÈDE, Hist. Nat. Poiss. i, 1798, p. 468, pl. xxxiii, fig. 2 ("cop. Willughby") ed. ii, 1819, ii, p. 343.
- Ostracion sex-cornutus*, MITCHILL, Amer. Month. Mag. ii, 1818, p. 328 (desc. of spec. from Gulf of Mexico near mouth of Mississippi River).
- Lactophrys sex-cornutus*, STORER, Mem. Amer. Acad. ii, p. 498; Syn. 1846, p. 246.
- Ostracion cornutus* (not Bl. or Linn.), MÜLL. and TROSCHE, in Schonburgk, Hist. Barbados. 1848, p. 677.
- Ostracion guineensis*, BLEEKER, Ned. Tyds. Dierk. ii, p. 298 (ou young individual).
- Ostracion Gronorii*, BLEEKER, l. c.
- Ostracion maculatus*, HOLLARD, op. cit. p. 149.
- Species dubia an Acanthostracion maculatum*, POEY, Rep. Fis. Nat. Cuba, ii, 1868, p. 439.
- Species dubia an Acanth. quadricorne mas*, POEY, Rep. Fis. Nat. Cuba, ii, p. 439.
- Acanthostracion polygonius*, POEY, Enum. Pisc. Cubens. 1876, p. 175.
- Quamajace apé*, MARCGRAVE, Hist. de Brasil, 1648, iv, p. 142 (fide CASTELNAU, l. c. p. 99).
- "*Guamaiaçu*, JONSTON, Pisc. tab. xxxvi, fig. 3, tab. xlv, sup. fig. 6," fide Bleeker.
- "*Piscis triangularis cornutus clusii*, WILLUGHBY, Hist. Pisc. 1686, xiv, tab. J."
- Piscis triangulus clusii cornutus*, RAY, Syn. Method. Pisc. 1713, p. 44.
- Ostracion triangulatus 2 aculeis in fronte et totidem in imo ventre*, ARTEDI, Syn. Pisc. 1738, p. 85, No. 9; Genera Piscium, 1738, p. 56, No. 5.
- Toro, PARRA, Desc. Dif. Piez. Hist. Nat. Cuba, ii, 1787, p. 81, pl. xvii, fig. 2.
- Piscis triangularis capite cornutus cui e media cauda cutacea aculeus longus erigitus*, LISTER, in App. Willughby, op. cit. p. 19.—RAY, l. c.
- Ostracion triangulatus, aculeis duobus in capite et unico longiore superne ad caudam*, ARTEDI, l. c. No. 10, Gen. Pisc. p. 56, No. 6.
- "*Piscis triangularis maxime cornutus squamis hexagonis et radiatis donatus*, LISTER, l. c. p. 15," fide Bleeker.

- Crayracina triangularis duobus cornibus curtis in fronte, etc.* KLEIN, Misc. iii, p. 21.
Coffre triangulaire à quatre épines, BONNATERRE, p. 21, pl. xiii, fig. 43.
Toro, Cuba (Anglice "Bull").
Cow-fish, Bermudas.
Cuckold, Jamaica.
Cuckold-fish, BLOCH, Ansl. Fische, p. 21, pl. xiii, fig. 43.

DISTRIBUTION.

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| St. Croix (Cope). | Tortugas (National Museum). |
| St. Martins (Cope). | Cape Florida (National Museum). |
| Bahamas (Cope). | Charlotte Harbor (National Museum). |
| Barbados (Schomburgk). | Pensacola (National Museum). |
| Jamaica (Günther, National Museum). | Mississippi (National Museum). |
| Santo Domingo (Günther). | South Carolina (National Museum). |
| Bahia (Günther, Castelnau). | West Africa (Bleeker). |
| Cuba (Poey, National Museum). | Indian Archipelago (Bleeker). |
| Near mouth of Miss. R. (Mitchill, 1818). | Cape of Good Hope (Bleeker). |
| Chesapeake Bay (Lugger). | |

Ostracions, with triangular carapace approaching to pentagonal form in adults, to tetragonal in young, by reason of extension of base of frontal spines, ventral surface plane, angles obtusely carinate, and with two ventral and two horizontal frontal spines. Color brown, yellow, blue or green, the centres of the scutes often lighter than the margins.

The range of the Cow-fish is much more extended than that of any of the preceding species, including St. Helena, Guinea, the Cape of Good Hope, and Charleston, S. C. A specimen was obtained October 11, 1877, near Gwyn's Island, Chesapeake Bay, by Mr. Otto Lugger. These localities are well authenticated, and the species is also claimed as a member of the fauna of the Indian Ocean. A sketch of *Ostracion quadricorne* by Burkhardt, marked "Mobile, 1853," is in the Agassiz collection. The sketch is also endorsed with a memorandum to the effect that a specimen from Florida was living in Aquarial Garden, Boston, 1860.

Bleeker admits this species to the fauna of the Dutch East Indies, but states expressly that he has never found it, and that he follows the authority of Bennett and Raffles, and that it is uncertain whether it really inhabits the Indian Archipelago.

I have never seen more than one species of this type, and the synonymy at the head of this notice expresses the views of the majority of ichthyologists as well as my own. It seems only fair, however, to quote the opinion of Dr. Bleeker. "It appears to me very evident," wrote he, "that there are at least five species of triangular (or rather pentagonal) *Ostracions* with frontal and preanal spines. Of these this (*O. quadricornis*) is the one longest known, and may be easily distinguished by the nearly vertical profile of the head as well as by the strong spine which terminates the postero-superior dorsal plate. The other species resembling *quadricornis* are *Ostracion notacanthus*, Bleeker, *Ostracion tricornis*, L. (= *Ostracion maculatus*, Hollard), *Ostracion Gronovii*, Bleeker, and *Ostracion guineensis*, Bleeker, but none of these exhibits the remarkable character of the postero-superior dorsal angle developed into a spine. *Ostracion notacanthus* is characterized by the presence of a

spine upon the dorsal crest, by its oblique profile, and by the hexagonal or irregular black ring with large yellowish centre which is plainly visible upon each plate of the back and the flanks; while *Ostracion Gronovii* is easily recognized by the greater length of the frontal and preanal spines, by the absence of the median dorsal spine, and by the very oblique profile of the snout. *Ostracion tricornis*, Linn., which appears to be identical with the species described by Hollard as *Ostracion maculatus*, is marked by its nearly vertical profile and by longitudinal brown bands upon the cheeks. *Ostracion guineensis* is marked by the subvertical profile of *O. tricornis*, but has cheeks without bands, and the plates of the carapace ornamented with a central ocella of pearl color or blue.*

The largest specimens, or the two types *O. quadricornis* and "*O. maculatus*," in the Paris Museum, had, according to Hollard, the following dimensions:

	<i>O. quadricornis.</i>	<i>O. maculatus.</i>
	M.	M.
Total length	0.400	0.390
Height	0.150*	0.120
Cephalic region	0.065	0.050
Tail-stem	0.060	0.080
Caudal	0.080	0.080
Abdominal width	0.090	

The presence of plates upon the caudal peduncle is apparently accidental. They may possibly have some relation to sex, but certainly none to age. Out of fourteen specimens examined five had plates above and below, one had two above, and six had none. In none of the specimens can I distinguish traces of the spine in the middle of the dorsal ridge mentioned by Dr. Günther. The color of young specimens is well described by Günther; the bands on the cheek are, however, of a bright blue. Adult specimens are colored in a rich bright blue or green, lighter in the centre of each hexagonal plate, giving the appearance of annular markings, which quickly vanishes after death. In some individuals the color is worn from the ridges of the carapace, leaving patches of light brown. Bleeker claimed for his species *Ostracion notacanthus* a peculiar system of coloration, but it is in nowise different from that of the ordinary type of *O. quadricornis*.† The largest specimens are 21 inches long.

In the Bermudas the Cow-fish is, I was told, much esteemed for food, and is frequently baked whole in its shell. The popular name, like the Cuban "*toro*" and the Jamaican "*cuckold*," refers to the two horn-like supraorbital spines.

* Misprinted 0.015.

† "Mais en outre le système de coloration de l'espèce que je crois nouvelle est très différent, chaque bouclier de la tête, du dos et des flancs étant orné d'un anneau violet ou noirâtre d'une forme hexagone, pentagone, quadrangulaire ou même ronde, et à centre large orange ou rougeâtre. On ne voit rien de pareil sur le corps du quadricornis. Puis encore, la queue est brunâtre et a taches jaunâtres et les pectorales ont un rayon de plus. Je nomme cette espèce nouvelle *Ostracion notacanthus*."—Mémoire sur le Poissons de la Côte de Guinée par P. Bleeker, p. 21.

OSTRACION QUADRICORNIS, LINN., SUBSP. NOTACANTHUS, (BLEEKER.)

Ostracion notacanthus, BLEEKER, Poiss. Guinée, 1863, p. 21 (St. Helena); Ned. Tyds. Dierk., ii, p. 298, et alibi.

This form, whose relations to *O. quadricornis* are discussed above, p. 267, p. 270, and p. 280, is recorded only from St. Helena. It will only be entitled to subspecific rank if in future it be shown that the dorsal median spine, sometimes observed in the young, remains persistent in the adult.

OSTRACION TURRITUS, Forskaol.

? *Ostracion gibbosus*, LINNÆUS, Syst. Nat. ed. x, 1758, p. 331; ed. xii, 1766, p. 409. (No description.)

Ostracion turritus, FORSKAL, Desc. Anim. Av. Amphib. Piscinum. ect. quae in itinere Orientali observavit, 1775, p. 75, No. 113.—BLOCH, "Ausl. Fische i, p. 113, pl. cxxxvi."—ICHTH. p. 117, pl. cxxxvi.—GMELIN, Linn. Syst. Nat. 1788, p. 1442.—WALBAUM, Artedi, Gen. Pisc. 1792, p. 476.—LACÉPÈDE, Hist. Nat. Poiss. ed. i, 1, 1798, p. 470.—SCHNEIDER, Bloch Syst. Ichth. 1801, p. 500.—BONNATERRE, Encyc. Method. Ichth., 1788, p. 22.—CUVIER, Règne Anim. ed. i, 1817, ii, p. 154, note; ed. ii, 1829, ii, p. 376, note; "ed. iii, Poiss. p. 346."—RUPPELL, "Reis. F. R. M. p. 5."—SWAINSON, Nat. Hist. Fish. Amphib. Rept. 1839, ii, p. 323.—HOLLARD, Ann. Sci. Nat. vii, 1856, p. 156.—BLEEKER, "V. Bat. Gen. xxiv, Bal. Ostr. p. 31; Act. Soc. Sc. Ind. N. vii, Zesde bijds. vischf. Jap. p. 13."

Ostracion (Tetrosomus) turritus, BLEEKER, Atl. Ichth. v, 1865, p. 31, pl. cciii, fig. 3.

Lactophrys camelinus, DEKAY, Zool. N. Y. Fish, 1842, p. 341, p. lviii, fig. 190.

Ostracion gibbosus, KAUP, Arch. für Naturg. Berlin, 1855, p. 218.—GÜNTHER, Cat. Fish Brit. Mus. viii, 1870, p. 258.

"*Ostracion prior* (or *alter*), ALDROVANDUS, De Piscibus, etc. (1638), iv, p. 561" ("copied by JONSTON, tab. xxv, fig. 6").

"*Ostracion alter gibbosus*, RAY, Synopsis, 1713, p. 44."

Ostracion alter gibbosus aldrovandi, WILLUGHBY, Hist. Pisc. 1686, tab. J, 9, fig. 1.

"*Crayracion triangularis gibbosus*, KLEIN, Miss. Pisc. iii, p. 20, No. 17."

Ostracion oblongo-quadrangulus gibbosus, ARTEDI, Gen. Pisc. 1738, p. 55.

Ostracion oblongus quadrangulus gibbosus, ARTEDI, Syn. Pisc. 1738, p. 83.

Ostracion dromadaire, LACÉPÈDE, op. cit.; ed. ii, 1819, p. 344.

DISTRIBUTION.

Indian Ocean and Archipelago (Günther).

I cannot follow Dr. Günther in accepting for this species the Linnæan name *Ostracion gibbosus*, since no description of this species was published by Linnæus. The first intelligible description was that by Foskaol, and although the indirect references to the figures published by Johnston, Willughby, and others, render it probable that this was the fish referred to by Linnæus, still there is no way of definitely ascertaining the meaning.

"Je crois reconnaître," wrote Bleeker,* "l'espèce actuelle dans les figures citées de Jonston, de Willughby, de Valentyn et de Renard. Celles de Jonston et de Willughby, copiées sur le même modèle, ne montrent ni l'épine frontale, ni celles de la carène ventrale, mais la grande épine dorsale y est assez bien rendus. Celles de Valentyn et de Renard, quoique grossières, ne laissent aucun doute par rapport à

* Atlas Ichthyologique, v, p. 32.

Pespèce qu'elles doivent représenter. Cependant c'est à Forskaol qu'on en doit la première description tolerable."

The diagnosis of *Limæus* in the twelfth edition of the *Systema Naturæ* is as follows :

"(Ostracion) gibbosus, 8. *O. tetragonus muticus*, gibbosus.
Art. gen. 55, syn. 83. *Ostracion quadrangulus*, gibbosus.
Habitat in Africa.
Varietatem speciei 1 credit Gronovius."

This species surely has no just claim to a place in the fauna of the United States.

De Kay inserted it in his work on the fishes of New York on very slight evidence. I quote the paragraph relating to the single specimen on which he based his description and figure :

"I know nothing of the origin of this species, except that it is said to have been taken on the shore of Long Island. It is possibly the species named *triqueter* by Dr. Smith, and which he represents as 'inhabiting the vicinity of Long Island, New York, but rarely makes its appearance so far to the north as Massachusetts, unless driven on shore by the violence of storms.' The *triqueter* of Artedi, however, has no spines. It bears a considerable resemblance to the *O. turritus* of Forskaol, from the Red Sea ; but that species is quadrangular." *op. cit.* p. 342.

There can be little doubt that the fish in De Kay's possession was a dried specimen of *O. turritus*, probably from a Chinese insect box.

Dr. Günther remarks that this species is "very closely allied to and probably identical with *O. gibbosus*" (viii, p. 259), but in his diagnosis he does not refer to any specimens intermediate in form between the two typical forms.

OSTRACION ARCUS, Schneider.

Ostracion arcus, SCHNEIDER, Bloch Syst. Ichth. 1801, p. 502 (citing Seba's figure).

Ostracion (Acanthostracion) arcus, BLEEKER, Atlas Ichthyologique, v, 1865, pp. 35-36, tab. ccii, fig. 3 (adult) ; cciv, fig. 4 (young), et alibi.

Ostracion cornutus, BLOCH (nec Linnaeus), Ansl. Fische, i, p. 105, pl. cxxxix.—BONNATERRE, Tabl. Encyclop. et Method. etc. Ichth. 1788, p. 22, pl. xiv, fig. 44.—LACÉPÈDE, Hist. Nat. Poiss. i, 1798, p. 470.—SCHNEIDER, l. c. p. 500 (?).—SHAW, Gen. Zool. v, 1803, p. 223, pl. clxx.—CUVIER, Règne Anim. 1 ed. 1817, ii, p. 154 ; 2d ed. 1829, p. 376, note ; "3d ed. Poiss. p. 346."—"BENNETT, Life of Raffles, 1830, p. 693."—RICHARDSON, Rep. 15th Meeting Brit. Assoc. ; Rep. Ichth. China and Japan, 1846, p. 200.

DISTRIBUTION.

Indian Ocean and Archipelago (Günther).

Micronesia (Günther).

Professor Gill, in his unpublished Bibliography of the Fishes of the West Coast of North America (p. 17), remarks that "a young specimen

(3½ inches long) of this species, dried, was sent (to him for identification) by Dr. Cooper, in behalf of the Geological Survey of the State of California, as having been given to them with the information that it had been obtained in the State." He notes that the appearance of the specimen led him to believe that it came from China, and in this opinion I would fully coincide, having carefully examined it. The species is provisionally included in this list. At some future time individuals may stray into our Pacific waters.

NOVEMBER 11, 1879.

ON THE HABITS OF THE ROCKY MOUNTAIN GOAT.

By DR. JAMES C. MERRILL, U. S. A.

FORT SHAW, MONTANA, *October 21, 1879.*

Professor S. F. BAIRD,

MY DEAR SIR: Since I last wrote to you I have passed two months at Fort Missoula, on the eastern limit of the Bitter-Root Range, and while there, finding that the wild goat was comparatively abundant, I made several attempts to obtain a skin and skeleton for the Smithsonian. I hunted them myself for two weeks, but unsuccessfully, only seeing one, and that I did not obtain. At that season they are in the highest and roughest peaks near and among snow, but in the winter come down to the lower slopes and valleys.

You may be interested in the following items concerning this species, which I obtained from trustworthy sources:

Accounts vary as to the *rutting* season and time of dropping the kids, but agree in the latter being two in number. During the summer the male, female, and kids keep together and until the appearance of the next young, though during the winter two or three of these families unite. At this season it is unusual to see more than a dozen together, though large bands are said to have been seen. The goats in all their movements are heavy and slow. They are most successfully hunted with dogs; when started by them they generally climb up the nearest rock and stand them off; and while so doing are easily approached and shot. When wounded and in close quarters they are rather dangerous, and are apt to use their horns with effect. They feed at sunrise and sunset, passing the day on some smooth flat rock in the sun, from which they can keep a good lookout, but rarely start until closely approached. The one I saw was among large masses of rock above snow-line. He got up within thirty yards of me, stood in full view for a moment, and then walked slowly off, almost hidden by the rocks. At first, though so near, I took him for an albino bear (and several old hunters told me they had made the same mistake!!); his large size, slow, heavy movements, and manner of looking back over the shoulder, with the absence of fear, being very different from my preconceived notions of the "white