THE SCALES OF SOME AUSTRALIAN FISHES.

By T. D. A. Cockerell, University of Colorado.

Through the continued efforts of Dr. R. Hamlyn-Harris, I am now able to report on the scales of a number of additional Australian fishes, some of them of more than ordinary interest. As before, it appears that with rare exceptions the Southern species have scales closely resembling their Northern congeners, when such exist. Although scales are very variable in certain respects, their general characters are very constant, and persist while other features of the fishes change, as for example in the Chætodontidæ mentioned below. Dr. Hamlyn-Harris informs me that not all the species discussed in my former contribution to these Memoirs (December, 1913) are from Queensland. *Holocentrus angustifrons* comes from New Britain; while *Pempheris multiradiatus, Cheilodactylus nigricans,* and *Eupetrichthys angustipes* are Southern species.

ELOPIDÆ.

Megalops cyprinoides (Broussonet). Queensland. Scales 7-7½ mm. broad, 6-7 long; formed as in *Tarpon atlanticus,* with even more deeply scalloped basal margin; basal radii about 7; laterobasal angles rounded; nucleus above the middle; apical margin very thin, with very numerous evanescent radii, but the distinct apical radii arising from the nucleus are only one or two, extremely variable and irregular, often branching; there are also sometimes lateral radii, one on each side, which may branch, and there may be formed an approach to an irregular network, not well defined, but indicating a condition exhibited by some species of *Barbus.* The circuli in the region above the nucleus are broken into minute tubercles; those below the nucleus are more or less evidently beaded.

These scales are essentially as in *Tarpon,* differing by the small size and greater number of basal radii. The basal circuli are much more regular and less crowded than in *Synodus.*

DOROSOMATIDÆ.

Dorosoma come Richardson. Queensland. Scales 5½-6 mm. broad, 5-5½ long; base with a bow-like (with double curve) outline; circuli very fine, wholly transverse; apical field very thin, without circuli, no apical teeth; radii about 12, transverse, rarely branching. The radii are more or less bent or obtusely subangulate in the middle, but not at all interrupted. The median lateral circuli and radii reach the margin at right angles.

These scales are wholly of a Clupeid type. Those of *Konosirus thrissa* (Philippine Is., U. S. Nat. Mus., 56105) differ conspicuously, having a single rather wavy transverse radius crossing the scale a little above the middle, and mere rudiments of radii at the sides below the middle, especially near the laterobasal corners. Above the transverse radius, close to the edge of the area covered by circuli, is a coarse irregular malleation. The scales are larger than those of *Dorosoma come*, and much broader than long.

CLUPEIDÆ.

Sardinella moluccensis Bleeker. Darnley Island. Scales about 5½ mm. broad and 4½ long; middle of base more or less prominently but obtusely lobed; circuli and radii wholly transverse; radii five, entire in normal scales, the lowermost arched upward; apical field thin, free from circuli; apical margin produced into numerous long parallel-sided strap-like teeth. Readily known from *S. numeralis* (Tampa, Florida) by the conspicuously toothed apical margin.

Harengula castelnaui Ogilby. Queensland. Scales about 7 mm. broad and 6½ long; basal outline gently convex; circuli and radii wholly transverse; radii four, or sometimes three, usually all entire; apical margin not dentate. Known from *H. perforata* by the absence of perforations in the apical area, and the somewhat smaller number of radii.

Amblygaster neopilchardus Steindachner. Queensland. Scales about 7½ mm. long and 7 broad, oblique, so that one of the laterobasal angles is very obtuse; basal margin almost straight or feebly lobed; circuli and radii (except the evanescent apical ones) all transverse; radii 6 or 7, all but the uppermost broadly interrupted in middle, the lower ones with the inner half strongly oblique; the thin apical field with numerous fine and weak parallel radial lines, all running upwards, and causing the margin to be subdentate.

Stolephorus robustus Ogilby. Queensland. Scales about 4½ mm. broad and a little over 3 long; basal margin very obtusely angulate in middle; apical field thin as usual, the margin coarsely and irregularly dentate, or rather crenulate, the teeth being short and obtuse; radii and circuli all transverse, the radii two or three, entire, the lowermost angulate in middle. There are frequently rudiments of radii. Compared with *S. brownii* (Cape Sable Creek) these scales are smaller, and much broader in proportion to their length, while the radii of *S. brownii* are much more developed, including vertical basal ones, and angular or zigzag ones in the apical field. *S. brownii* also has a double system of circuli, though the basal ones are much more transverse than those of *Engraulis antipodum*. According to the scales, *antipodum* and *brownii* should be congeneric, while *S. robustus* stands apart.

Potamalosa novæ-hollandiæ Valenciennes. New South Wales. Scales about 8-9 mm. broad and 6½-7 long; basal margin gently convex, not lobed; circuli very fine, covering not much more than half of scale, curving upward at sides, reaching the margin very obliquely; apical field without distinct sculpture, the margin not dentate; a strong entire transverse radius crosses near the middle of the scale; basally and sublaterally are many (16 or more) more or less incomplete radii, directed toward the nucleus. In young scales the circuli appear more transverse.

Hyperlophus sprattellides Ogilby. Queensland. Scales less than 5 mm. broad, broader than long or about as broad as long; basal margin usually extended in middle; circuli transverse, covering little more than half of scale; a transverse radius (usually more or less arched upward) crosses the middle of the scale; and there are from none to four incomplete basal radii; apical field delicately radiate and conspicuously dentate.

ENGRAULIDIDÆ.

Engraulis antipodum Günther. Queensland. Scales about 3½ mm. broad and nearly or quite as long; basal margin more or less convex in middle and concave sublaterally; apical field thin and without circuli, the margin not at all dentate; region about and just above middle of scale with very fine transverse circuli, like those of the clupeids; region below the middle with fine but much more widely spaced circuli, which curve upwards at the sides, as in non-clupeid fishes, the two systems of circuli meeting at the sides, but abruptly discontinuous; radii very irregular, largely bent or zigzag, apical as well as lateral and basal, but few, mostly pointing to the middle of the scale, the apical ones sometimes meeting and forming a broad V.

CHIROCENTRIDÆ.

Chirocentrus dorab Forskal. Queensland. The scales sent show fine transverse circuli, and no radii whatever. The apical field is without sculpture, and its margin entire. The area covered with circuli extends in the middle as a rounded lobe into the apical field. All this is very different from *C. dorab* from the Philippine Is., which has well-developed radii, as well as different circuli. It would seem probable that the fishes belong to different species. In neither case did I see the fish itself.

Dr. Max Ellis has in preparation a paper on Clupeoid scales, which will include a discussion of various Australian species, and will go into a number of matters not touched upon here, where I give only what is necessary to complete this report. The following key separates the Clupeoid scales now described:—

No radii; apical margin entire	*Chirocentrus dorab.*
Radii present	1.
Basal field with vertical radii	2.
Basal field without vertical radii	3.
2. Apical field with distinct transverse or V-like radii	*Engraulis antipodum.*
Apical field without such radii	*Potamalosa novæ-hollandiæ.*
3. Transverse radii, except the uppermost regularly interrupted in middle	*Amblygaster neopilchardus.*
Transverse radii not or rarely interrupted	4.
4. Transverse radii 3 or 4, rarely fewer	5.
Transverse radii more numerous	6.
5. Apical margin coarsely crenulate	*Stolephorus robustus.*
Apical margin not crenulate	*Harengula castelnaui.*
6. Apical margin with long strap-like teeth	*Sardinella moluccensis.*
Apical margin without teeth	*Dorosoma come.*

ATHERINIDÆ.

Rhadinocentrus ornatus Regan. Queensland; Moreton Bay. Scales transversely oval or oblong, about $2\frac{1}{2}$ mm. broad and $1\frac{1}{2}$ long; completely cycloid; corners rounded, the laterobasal slightly angular; circuli fine, all round scale; basal radii numerous (about 12). The scales resemble those of the Pœciliidæ. Those studied are latinucleate, with a large sculptureless nuclear field.

Rhombatractus fitzroiensis Castelnau. Queensland; Brisbane, fresh water. Scales about $2\frac{1}{2}$ mm. broad and $1\frac{3}{4}$ long; completely cycloid; laterobasal corners rectangular; nuclear region a short distance above the middle; about ten basal radii; circuli fine and regular, except in the apical field, where they are mainly broken into small pustuliform markings; slight suggestions of apical radii on some scales.

R. maccullochi Ogilby. Queensland. Scales almost exactly as in the other species, except that the circuli are practically absent in the apical field, not represented by pustuliform markings.

These scales resemble those of *Menidia menidia,* except that they are much smaller, the laterobasal angles are more distinct, and the lateral circuli are much denser.

MUGILIDÆ.

Mugil cephalus dobula Günther. Queensland. Scales subquadrate, about 10 mm. broad and 11 long; basal radii about 8 to 12, subparallel, not crowded about middle of scale; laterobasal corners evident; ctenoid area very well developed, the elements contiguous throughout; region above the nucleus covered with fine labyrinthiform markings. The basal circuli are extremely fine and dense; much more so than in *M. curema.* The shape of the scales is entirely different from that of *M. curema.*

POLYNEMIDAE.

Polydactylus multiradiatus (Günther). Queensland: Thursday Island. Scales quadrate, about 8 mm. broad and long; the [illegible] fairly converging toward the apical region; basal radii 4 to 5, irregularly placed, the midmost one ending in a deep notch or sinus in the basal margin; nucleus far above the middle; ctenoid area very well developed, [illegible] sharp teeth on the margin, and about six rows of hexagonal elements below them. Compared with the scales of *P. octonemus*, these are much smaller, but entirely of the same type, with the same characteristic basal notch. On minute comparison, one rather important difference is noted: the subapical elements of the ctenoid area are shorter, especially several rows from the margin, in *P. multiradiatus* than in *P. octonemus*.

MULLIDAE.

Upeneus malabaricus Cuv. & Val. Darnley Island. Scales very large, more or less semicircular, about 15 mm. broad and 11 to 12 long; circuli excessively fine and dense; basal radii 5 or 6; basal margin scalloped; nucleus far above middle; ctenoid area very well developed; many of the marginal teeth bifid.

This nearly agrees in structure with the scales of *U. vittatus*, but the bifid apical teeth are distinctive; and whereas in *U. vittatus* there are very fine circuli running transversely just below the sharply limited ctenoid area, in *U. malabaricus* this region is occupied by a minutely tubercular or subreticulate pattern. The fine lines below the ctenoid area in *U. vittatus*, though referred to as circuli, and certainly part of that system, are much denser and finer than the basal or typical circuli, which they meet at right angles laterally, while below they are broken up into minute vermiform lines, which partly correspond with the circuli, but mainly occupy the spaces between them. The minute pattern occupying the same region in *U. malabaricus* is also derived from the circuli, but it is very different in appearance.

In *Pseudupeneus multifasciatus* from Honolulu (Jordan and Evermann; U.S. Nat. Mus.), the scales are entirely of the same general type, with excessively fine circuli, and five or six basal radii. The area below the ctenoid patch has fine transverse lines (as in *U. vittatus*) on the middle third only, the lateral thirds having fine circuli running vertically (at right angles to the transverse lines) up to the ctenoid patch. In addition, this region, as well as the adjacent part of the ctenoid patch, shows rather large round pustuliform markings. This last feature is apparently indicated by hyaline spots in *U. malabaricus*.

CARANGIDAE.

Caranx speciosus Forskål. Queensland. Scales circular or more or less oblong, 2 to rather over 3 mm. diameter; margin simple; no radii; normal circuli [illegible] this report. The following key separates the Clupeoid scales now described:—

[illegible] [illegible] scales [illegible] . . . . . . *[illegible]* . . . . .
[illegible] . . . . . . 2.
[illegible] radii . . . . . . 3.
[illegible] radii . . . . . . 4.
[illegible] with distinct transverse [illegible] radii . . . . . . *[illegible]*.
[illegible] field without such radii . . . . . . *[illegible]*.
[illegible] radii [illegible] . . . . . . *[illegible]*.

[illegible] radii not [illegible] . . . . . . 5.
[illegible] radii [illegible] . . . . . . 6.
[illegible] . . . . . . 7.
[illegible] margin [illegible] . . . . . . *[illegible]*.
[illegible] margin not [illegible] . . . . . . *[illegible]*.
[illegible] margin with long [illegible] teeth . . . . . . *[illegible]*.
[illegible] margin without teeth . . . . . . *[illegible]*.

[illegible]

[illegible] *[illegible]* [illegible]. Queensland: Moreton Bay. Scales [illegible] oval or oblong, about [illegible] mm. broad and [illegible] long; completely [illegible], rounded, the [illegible] slightly angular; circuli fine; all [illegible] radii [illegible] (Fig. [illegible]). The scales resemble those of [illegible]. Those studied are [illegible], with a large sculptureless [illegible] field.

[illegible] *[illegible]* [illegible]. Queensland: Brisbane, fresh water. Scales about [illegible] mm. broad and [illegible] long; completely cycloid; lateral [illegible] a [illegible] rectangular notch [illegible] a short distance above the middle; about [illegible] radii; circuli [illegible] regular, except in the apical field, where they are [illegible] broken into [illegible] markings; slight suggestions of apical [illegible] scales.

S. [illegible] [illegible]. Queensland. Scales almost exactly as in the other species, except that the [illegible] practically absent in the apical field, not [illegible] by [illegible].

These scales resemble those of [illegible], except that they are much [illegible], and the lateral circuli are much denser.

[illegible]

[illegible] [illegible]. Queensland. Scales subquadrate, about 10 mm. broad and [illegible] long; basal radii about [illegible] to [illegible], subparallel, not crowded [illegible]; [illegible] very well developed, the [illegible] throughout; region above the [illegible] covered with fine [illegible] markings. The basal circuli are extremely fine and dense, much more so than in *M. [illegible]*. The shape of the scales is entirely different from that of *M. [illegible]*.

POLYNEMIDÆ.

Polydactylus multiradiatus Günther. Queensland; Thursday Island. Scales quadrate, about 3 mm. broad and long, the practically straight sides gently converging toward the apical region; basal radii 4 to 6, irregularly placed, the midmost one ending in a deep notch or sinus in the basal margin; nucleus far above the middle; ctenoid area very well developed, forming sharp teeth on the margin, and about six rows of hexagonal elements below this. Compared with the scales of *P. octonemus,* these are much smaller, but entirely of the same type, with the same characteristic basal notch. On minute comparison, one rather important difference is noted: the subapical elements of the ctenoid area are shorter, especially several rows from the margin, in *P. multiradiatus* than in *P. octonemus.*

MULLIDÆ.

Upeneus malabaricus Cuv. & Val. Darnley Island. Scales very large, more or less semicircular, about 15 mm. broad and 11 to 12 long; circuli excessively fine and dense; basal radii 5 or 6; basal margin scalloped; nucleus far above middle; ctenoid area very well developed; many of the marginal teeth bifid.

This nearly agrees in structure with the scales of *U. dentatus,* but the bifid apical teeth are distinctive; and whereas in *U. dentatus* there are very fine circuli running transversely just below the abruptly limited ctenoid area, in *U. malabaricus* this region is occupied by a minutely tubercular or subreticulate pattern. The fine lines below the ctenoid area in *U. dentatus,* though referred to as circuli, and certainly part of that system, are much denser and finer than the true or typical circuli, which they meet at right angles laterally, while below they are broken up into minute vermiform lines, which partly anastomose with the circuli, but mainly occupy the spaces between them. The minute pattern occupying the same region in *U. malabaricus* is also derived from the circuli, but it is very different in appearance.

In *Pseudupeneus multifasciatus* from Honolulu (Jordan and Evermann; U.S. Nat. Mus.), the scales are entirely of the same general type, with excessively fine circuli, and five or six basal radii. The area below the ctenoid patch has five transverse lines (as in *U. dentatus*) on the middle third only, the lateral thirds having fine circuli running vertically (at right angles to the transverse lines) up to the ctenoid patch. In addition, this region, as well as the lowermost part of the ctenoid patch, shows rather large round pustuliform markings. This last feature is apparently indicated by hyaline spots in *U. malabaricus.*

CARANGIDÆ.

Caranx speciosus Forskal. Queensland. Scales circular or more or less oblong, 2 to rather over 3 mm. diameter; margin simple; no radii; normal circuli all around, except that the extreme margin, especially at sides of apex, is hyaline and without sculpture; basal circuli conspicuously denser than apical or lateral.

These scales do not differ materially from those of *C. hippos.*

STROMATEIDÆ (including NOMEIDÆ).

Psenes whiteleggii Waite. Queensland. Scales very variable, the largest scarcely 1½ mm. broad, broader than long; but others, probably from the caudal region, smaller, and longer than broad; margin simple; three or fewer basal radii; basal margin variably but usually strongly lobed; circuli normal, widely spaced.

Gobiomorus gronovii has scales of the same general type, but without radii. The scales of *Poronotus triacanthus* are much larger than those of *Psenes,* but otherwise very similar, though with much denser circuli. The lateral circuli are often distinctly angular, and the same feature may be seen in some scales of *Psenes.*

PEMPHERIDÆ.

Pempheris compressus Shaw. Port Jackson. Scales (from different parts of the fish, presumably) differ greatly in size, the largest are nearly 4½ mm. broad and fully 3¼ long; a strong arched ridge runs across the scale just above the nucleus, separating the larger apical field, which is without circuli or other distinct sculpture, except the marginal ctenoid area; marginal teeth long and sharp, on all the scales examined; submarginal ctenoid elements broader than long; sides of apical field variably constricted (concave) just above the ends of the transverse ridge; part of scale below the ridge covered with normal circuli; basal radii many, but feeble, being folds rather than true radii, arranged in a fan-like manner (except in latinucleate scales); basal margin of larger scales straight, weakly crenulate, but some of the smaller scales have three lobes, the median one very large, separated from the others by deep sinuses.

Parapriacanthus elongatus McCulloch. Bass Straits. Scales about 3 mm. broad and 2 long; divided into two parts more or less as in *Pempheris compressus,* but wholly cycloid, or with the apical margin thrown into one or two broad dentiform prominences, without any cycloid patch; transverse ridge straighter and weaker than in *P. compressus*; apical half of scale without circuli, basal half with strong normal circuli; at the beginning of the basal half the scale suddenly widens, making an angle with the vertical sides of the apical half; no distinct basal radii or lobes, but there are very indistinct traces of radial folds.

These scales are very remarkable; those of *P. compressus* are quite unlike those of the species of *Pempheris* previously seen (Mem. Queensl. Mus., Dec. 1913, p. 54). In the presence of a distinct ctenoid patch, *P. compressus* resembles *Leptobrama mülleri,* but the submarginal elements in that fish are very different, being longer than broad. There is an evident relationship between *P. compressus* and *Parapriacanthus elongatus,* though they differ greatly in detail. Ogilby (Mem. Queensl. Mus., 1913, p. 66) refers *Pempheris multiradiatus* to *Liopempheris,* a genus differing from true *Pempheris* in having both cycloid and ctenoid scales, the latter with large marginal teeth, but no ctenoid patch. *Catalufa* Snyder includes *P. compressus,* and considering the character of the scales, described above, the genus is perhaps valid. The species from the Red Sea, the scales of which I described in the place cited, is presumably not *P. otaitensis,* as provisionally determined, but rather *P. macrolepidota.* If it belongs to typical *Pempheris,* the genus cannot be defined as Ogilby has it in his work just cited. With reference to the remarks on p. 62 of Ogilby's paper, it is worth while to add that *P. mülleri* Poey is the type of *Priacanthopsis* Fowler. Fowler merely says "Anal rays 25-32." There is apparently nothing to indicate a distinct genus.

It must be considered certain that *Catalufa* (*compressa*) is a genus distinct from *Liopempheris*; but it remains to be definitely determined whether typical *Pempheris* is a third genus, distinct from both of these.

ENOPLOSIDÆ.

Enoplosus armatus Shaw. Queensland. Scales about 3½ mm. long and a little over 2 broad; apex rounded, simple; sides parallel; basal margin straight or nearly, feebly scalloped; nucleus a little above the middle; basal radii very distinct, 6 to 11, arranged fanwise; circuli normal, but twice as numerous in the region of the basal radii as at the sides; apical field with irregular minute round markings. There is no apical area free from circuli.

Superficially, these scales are like those of the Labridæ, but the apical field is entirely different. Except that they wholly lack the ctenoid patch, they rather closely resemble some Serranidæ, as *Paralabrax.*

Ambassis interrupta (New Guinea; U. S. N. Mus.) has scales with broadly rounded completely cycloid margins, the very fine circuli extending right across the apical field, and completely covering it. There are about seven basal radii. The *Ambassis* scale is, however, entirely different from that of *Enoplosus* in being short, much broader than long; and in having the apical circuli, which are much finer than the basal ones, meeting the basal at very acute angles laterally. Thus, in the circuli, there is an approach to the condition of certain Scombrids. We must suppose that these scales are secondarily cycloid, derived from ctenoid ancestors.

SILLAGINIDÆ.

Sillago ciliata Cuv. & Val. Queensland. Scales quadrate, or broader than long, about 1-1½ mm. diameter; basal radii about 5 to 7; nucleus subapical; circuli not dense, but considerably denser between the radii than at sides; ctenoid patch well developed but narrow; apical teeth long; subapical elements (one or two rows) broader than long, with a raised phalangiform median structure, corresponding to the shaft of the apical tooth. These scales are much smaller than those of *S. maculata,* and also narrower, but the structural characters exactly agree.

GERRIDÆ = XYSTÆMIDÆ.

There is also a family Gerridæ in Hemiptera, based on *Gerris.* As the insect family appears to have priority, the Gerridæ of Ichthyology may take the name XYSTÆMIDÆ.

Xystæma darnleyensis Ogilby. Darnley Island. Scales broader than long, about 5-7 mm. broad and 4½ long; about 3 to 5 widely divergent, rather weak basal radii; lower margin undulate; nucleus above the middle; circuli extremely fine and dense, transverse, confined to the region level with and below the level of the nucleus; apical field without sculpture; apical margin simple. In some scales the nucleus is surrounded by 5 or 6 complete (circular) circuli, and the circuli for some distance beyond are also circular, but cut off above at the level of the nucleus. The laterobasal circuli also curve upwards, reaching the margin at a very acute angle, though the uppermost lateral circuli reach it practically at a right angle.

This is a typical Gerrid (Xystæmid) scale, except that it has lost the last rudiments of the ctenoid patch. In *Gerres rhombeus* (Mindi Cut, Panama Canal Zone; Meek and Hildebrand) there is a triangular weakly ctenoid patch, the lower corner elongated and pointing to the nucleus. In *Eucinostomus californiensis* (Mindi Cut; Meek and Hildebrand) the ctenoid patch is broad, and the circuli are completely transverse, even at the laterobasal corners. Thus *E. californiensis* is most specialised as to its circuli, but *X. darnleyensis* has gone farther in the direction of the loss of ctenoid elements.

POMACENTRIDÆ.

Amphiprion percula L. Darnley Island. Scales subquadrate, about 1 mm. broad and ⅘ mm. long; nucleus a little above the middle; basal radii 5 to 7, very distinct; basal margin crenate or scalloped; circuli normal; ctenoid patch very well developed; marginal teeth sharp, with broad bases.

These differ from other Pomacentrid scales seen in having the circuli relatively much less dense, and the lateral margins of the apical teeth more or less concave instead of straight. The subapical ctenoid elements are inclined to be more or less bottle-shaped.

EPHIPPIDÆ.

Scatophagus ætate varians de Vis. Queensland. Scales very small, diameter about 1-1½ mm.; quadrate, as broad as long, or considerably broader than long; lower margin wavy but not crenate; laterobasal corners obtuse, but often projecting, the lateral margins then concave; no radii; circuli rather coarse, transverse as far as an obtuse ridge which extends on each side from nucleus to laterobasal corner, then bending and ascending vertically at sides; nucleus just below the apical margin; margin with large, very sharp teeth (about 24), and rows of similar teeth usually (not always) present in the submarginal region, whence they are easily deciduous. There is no ctenoid patch of the ordinary type. *S. multifasciatus,* as figured by Günther, has similar teeth.

This is a very remarkable type of scale, rather suggestive of *Percopsis.* In *Columbia transmontana* (U. S. Nat. Mus.) the scales are very broad, and have a subapical nucleus, and a single (never more than one) row of large and sharp apical teeth (about 20-24); they also are without radii. The scale of *Columbia* is much broader than that of *Scatophagus,* the sides are very much shorter, and the circuli are not so dense.

PLATACIDÆ.

Platax teira Forskal. Queensland. Scales subquadrate, as broad as long, or broader than long, diameter about 2½-3 mm., peculiar for the contracted base, so that the sides converge downwards; laterobasal corners very obtuse; basal radii 3 or 4, very distinct, but close together; circuli fine, normal; nucleus subapical, just below the ctenoid patch, which is only 3 or 4 rows deep; marginal teeth long and sharp; submarginal elements shaped like tree-stumps, distinctly longer than broad.

This resembles *Scatophagus* in the subapical nucleus, but is otherwise very different. Some scales of *Pomacanthus arcuatus* show the contracted base very well.

CHÆTODONTIDÆ.

The species now before me may be separated into three groups as follows:—

Median ribs of apical teeth extending as continuous rods to base of ctenoid area .. .. *Pomacanthus arcuatus.*

Ctenoid patch large, with the elements separate, as usual in Acanthopterygian scales .. 1.

1. Scales much longer than broad, parallel-sided; nucleus subapical, just below the ctenoid patch; basal radii 6 to 8; circuli excessively fine; ctenoid elements like those of *Chætodon* (Queensland) .. .. *Microcanthus strigatus* Langsd.

Scales not longer than broad, usually broader than long *Chætodon, Chelmon,* and *Heniochus.*

It is impossible to find satisfactory characters for the separation of the species of *Chætodon, Chelmon,* and *Heniochus.* The ctenoid elements of *Chelmon* are coarser than those of *Heniochus,* but the structure is the same. The scales of these fishes must be easily deciduous, judging from the large number of latinucleate ones.

The species examined are—

Chætodon ephippium C. & V. Queensland.
„ *octofasciatus* Bloch. „
„ *flavirostris* Günther. „
„ *trifasciatus* Park. „
„ *ulietensis* C. & V. Samoa.
„ *bricei* Smith. Atlantic.
Heniochus chrysostomus C. & V. Queensland.
Chelmon rostratus C. & V. Queensland.

SCALES OF POMACANTHINÆ.

(1) The scales of *Holacanthus* and *Chætodontoplus* are entirely of the same general type as those of *Pomacanthus.* (Cf. Bull. U. S. Bur. Fish., xxxii, p. 167, f. 39.)

(2) These scales are very different in their ctenoid area from those of the *Chætodontinæ,* and taking this fact along with others, it may perhaps be a question whether the *Pomacanthinæ* should not stand as a distinct family *Pomacanthidæ.*

(3) Having in view the characters of related families, there can be no doubt, I think, that the scale-characters of the *Pomacanthinæ* are strongly modified from the more primitive type of the group, which is much more nearly approached by the *Chætodontinæ.* The special modification is however entirely in the ctenoid (apical) area.

(4) Among the *Holacanthinæ, Holacanthus bicolor* shows the nearest approach to the chætodontine scales, having the lower (mesad) part of the ctenoid area with small separate elements, instead of the usual continuous long rods or ridges. There is some indication of this sort of thing in *Pomacanthus arcuatus.*

(5) *Holacanthus bicolor,* with its well defined converging basal radii, appears to approach a relatively primitive type; but its ctenoid area, with long parallel rods, seems extremely modified. There is a singular resemblance, doubtless quite superficial, to the ctenoid area of *Aphrododerus* (Bull. U. S. Bur. Fish., xxxii, p. 153, f. 13).

(6) The *Chætodontoplus* scale with its comparatively narrow form and rounded base is peculiar, but the ctenoid area agrees with that of *H. bicolor.* The differences are much less significant than the resemblances.