

UNIVERSITY OF MICHIGAN
MUSEUM OF ZOOLOGY

Miscellaneous Publications No. 16

Studies of the Fishes of the
Order Cyprinodontes
VI

BY

CARL L. HUBBS

ANN ARBOR, MICHIGAN
PUBLISHED BY THE UNIVERSITY
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ALEXANDER G. RUTHVEN,
Director of the Museum of Zoology,
University of Michigan.

STUDIES OF THE FISHES OF THE ORDER CYPRINODONTES

BY CARL L. HUBBS

VI. MATERIAL FOR A REVISION OF THE AMERICAN GENERA AND SPECIES

In the first paper of this series there was discussed and proposed, briefly, A Classification of the Fishes of the Order Cyprinodontes; in the second, An Analysis of the Genera of the Poeciliidae, one of the seven families into which the order was divided. The third paper dealt with The Species of *Profundulus*, a New Genus from Central America; the fourth, with The Subspecies of *Pseudoxiphophorus bimaculatus* and *Priapichthys annectens*. These four numbers were published as Miscellaneous Publication Number 13 of the Museum of Zoology (Jan. 18, 1924, pp. 1-31). The fifth paper contained Notes on Species of *Goodea* and *Skiffia* (Occ. Pap. Mus. Zool., Univ. Mich., No. 148, Apr. 26, 1924, pp. 1-8).

In the present paper, the sixth of the series, miscellaneous notes are presented on the American genera and species of most of the groups of Cyprinodontes. It is largely made possible by the generosity of Dr. Eigenmann, of Indiana University, who loaned us the entire collection of cyprinodont fishes belonging to that institution, and of the officials of the Field Museum and of Stanford University, who have assisted in the study by the loan of material and in other ways. Dr. Elinor Behre submitted a large series of poeciliids collected by her in westernmost Panama and Costa Rica.

The following new genera and subgenera are erected in the present work:

<i>Cubanichthys (cubensis)</i>	<i>Arthropallus (patruelis)</i>
<i>Floridichthys (mydrus)</i>	<i>Schizopallus (holbrookii)</i>
<i>Lermichthys (multiradiatus)</i>	<i>Trigonophallus (punctifer)</i>
<i>Balsadichthys (whitei)</i>	<i>Poecilistes (lutzi)</i>
<i>Heteropallina (regani)</i>	<i>Autopallus (elongatus)</i>
	<i>Micropoecilia (parae)</i>

Five new species are also described:

<i>Gambusia vittata</i>	<i>Gambusia panuco</i>
<i>Gambusia regani</i>	<i>Trigonophallus punctifer</i>
	<i>Poeciliopsis balsas</i>

Family 1. CYPRINODONTIDAE

Subfamily 1. FUNDULINAE

As Myers has pointed out, the name Fundulinae Jordan and Gilbert, 1883, is older than that of Haplochilinae Garman, 1895.

Genus 1. *Adinia* Girard

In addition to characters already appreciated, the entire absence of any pouch-like modification about the anal fin of the female may be mentioned as a feature distinguishing this genus from *Fundulus*.

1. *Adinia multifaciata* Girard

We have a specimen of this rather rare species, taken by F. M. Gaige at Pine Key, one half mile east of Pass-a-Grille, Long Key, Florida.

Genus 2. *Cubanichthys*, new genus

Type: *Fundulus cubensis* Eigenmann.

Size minute. Body robust, with symmetrical outlines. Dorsal fin in advance of anal; both these fins elevated and pointed posteriorly. Scales very large, only 24 in lateral line. Genital opening protected by a pair of specialized scales, which in the female become enlarged, functionally replacing the membranous pouch diagnostic of *Lucania*, *Chriopeops*, *Plancterus*, *Oxyzygonectes*, and all species of *Fundulus* as currently restricted. Teeth biserial.

Cubanichthys is very closely related to *Chriopeops* of Florida, differing most sharply in the structure of the urogenital opening.

(*Cubanichthys*: named for Cuba, to which island the genus appears to be confined.)

2. *Cubanichthys cubensis* Eigenmann

Fundulus cubensis Eigenmann, Bull. U. S. Fish Comm., 1902 (1903), p. 222, fig. 1; Myers, Am. Mus. Nov., No. 116, 1924, p. 8.

Chriopeops cubensis Myers, The Fish Culturist, 4, 1925, p. 370.

The material examined consists of specimens collected by Haseman and McIndoo at Batabano, Cuba, and of one paratype.

Genus 3. *Leptolucania* Myers

Leptolucania Myers, Am. Mus. Nov., No. 116, 1924, p. 8; The Fish Culturist, 4, 1925, p. 370.

This genus differs from *Lucania*, from which it has only lately and provisionally been separated, in several ways. The membranous oviducal

pouch characteristic of *Lucania* (and *Fundulus*) is lacking. The axis of the body is angulated, instead of being straight, and the dorsal fin is inserted posteriorly instead of medially (characters associated with surface rather than mid-water swimming habits). The chin is vertical, not oblique. The coloration is variegated instead of being relatively plain excepting the dark margining of the scale pockets.

The resemblance of *Leptolucania* to *Rivulus* in some structural features and especially in coloration may or may not be fortuitous. It is clear, however, that the two genera are distinct, for in *Leptolucania* the orbit has a free margin, and the teeth are uniserial.

3. *Leptolucania ommata* Jordan

Specimens of this minute cyprinodont collected in Prairie Creek, six miles southeast of Gainesville, Florida, and in ponds near Haines City, Florida, have been examined.

The dark, diffused band, which extends forward from the ocellation surrounding the caudal spot in the female, does not follow the downturned axis of the tail region, but rather is parallel with the axis of the trunk, and probably also with the water surface when the fish is in normal position against the surface. In one specimen traces of bars pass through the band, and in another a black spot is developed in the course of the band, on each side.

Genus 4. *Chriopeops* Fowler

Chriopeops Fowler, Proc. Acad. Nat. Sci. Phila., 58, 1916, p. 425 (as a subgenus); Myers, Am. Mus. Nov., No. 116, 1924, p. 8 (as genus).

This genus agrees with *Fundulus* and its allies in the development of a urogenital pouch about the front of the anal fin. The teeth are in two series in each jaw, not in one row as in *Lucania* nor in a band as in *Fundulus*.

4. *Chriopeops goodei* Jordan

In addition to series already recorded, specimens of this species from Bivens Arm at Gainesville, and De Leon Springs, both in Florida, have been examined.

Genus 5. *Lucania* Girard

This genus agrees with *Fundulus* in that the urogenital opening is surrounded in the female by a membranous pouch. It differs in that the teeth are in a single series (rarely irregular) instead of in a band.

Seven specific names are or have been associated with *Lucania*. In order of proposal these are:

Cyprinodon parvus Baird and Girard, 1855.

Lucania venusta Girard, 1859.—After examining many series of specimens, I am not able to confirm the current distinction of this nominal species from *Lucania parva*.

Lucania affinis Girard, 1859.—A synonym of *venusta* and hence of *parva*.

Lucania goodei Jordan, 1879.—Transferred by Garman to *Fundulus* and by Fowler made the type of a distinct subgenus, *Chriopeops*, which lately has been recognized as a distinct genus.

Heterandria ommata Jordan, 1884.—While retaining this species in *Lucania*, Myers has lately erected for it the new subgenus *Leptolucania*.¹ This subgenus should be elevated to generic rank.

Zygonectes manni Hay, 1885.—A synonym of *ommata*.

Lucania browni Jordan and Richardson, 1907.² A species of *Cyprinodon*, the teeth of the type being tricuspid, instead of "sharp, pointed, equal" as erroneously claimed in the type description.

5. *Lucania parva* Baird and Girard

So far as apparent from a study of large series of specimens from many localities throughout the known range of the genus, the variation in depth of body held to distinguish *venusta* from *parva* has no clear geographic correlation. Some of the slenderest specimens come from near the northern end of the range of *parva*, which is supposed to be the deep-bodied form.

Consequently, *Lucania venusta* and *L. affinis* are regarded as synonymous with *Lucania parva*. Myers has recently come to the same conclusion (*The Fish Culturist*, 4, 1925, p. 370).

Genus 6. *Fundulus* Lacépède

At present there appear to be no characters by which the genus *Fundulus*, as currently restricted, may be satisfactorily divided, either into subgenera or genera. As in *Lucania*, *Chriopeops* and *Plancterus*, the urogenital opening of the female is surrounded by a diagnostic membranous pouch, which embraces the front of the anal fin. In most of the species the pouch is extended for but a short distance along the front of the anal fin, whereas in others, *heteroclitus* and its subspecies or allies, including "*nisorius*" (the last-named ascribed, probably by error, to West Africa), the pouch is contracted and extended to form a tube along the front of the fin. In some mature specimens of *grandis*, however, the tube is developed hardly better than in some of *majalis*.

6. *Fundulus heteroclitus* Linnaeus

This species is divisible into several subspecies.

¹ *Am. Mus. Nov.*, No. 116, 1924, p. 8.

² *Proc. U. S. Nat. Mus.*, 33, 1907, p. 320.

6a. *Fundulus heteroclitus grandis* Baird and Girard

The synonymy of this subspecies as given by Garman³ should apparently be accepted, with the exclusion of *Fundulus ocellaris* Jordan and Gilbert and of *Fundulus pulvereus* Evermann. The latter, on comparison, appears to be a very different species, related rather to *cingulatus* and its allies.

Specimens recorded as *Fundulus similis* by Evermann and Bean⁴ from Pelican Island, off the east coast of Florida, and by Meek⁵ from Mexico, prove on re-examination to be referable rather to the present form. Records of *Fundulus heteroclitus* from Mexico⁶ are apparently all based on *grandis*. Meek (*l. c.*) erroneously makes it appear that Evermann and Goldsborough⁷ recorded *heteroclitus* from Progreso, Yucatan. This they did not do: they recorded only *grandis*, mentioning some of the features which they thought separated the two species. These are not, however, the characters which distinguish the two forms. It is possible that the Yucatan form is not referable to *grandis*; it has also been discussed by Barbour and Cole.⁸

6b. *Fundulus heteroclitus fonticola* Cuvier and Valenciennes

? *Fundulus antillarum* Fowler, Proc. Acad. Nat. Sci. Phila., 68, 1916, p. 418, fig. 1.

Fundulus fonticola Cuvier and Valenciennes, Hist. Nat. Poiss., 28, 1846, p. 198; Jordan, Proc. U. S. Nat. Mus., 9, 1886, p. 526; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 643.

There is little in the accounts of *fonticola* to distinguish it from the other forms of the *heteroclitus* group. As Dr. Jordan redescribed it, the high pointed anal would probably distinguish it from *grandis*, while the more slender tail would separate it from *heteroclitus*. In both of these respects it would appear like *bermudae*, and perhaps the two are identical. Actual comparison of material, however, can alone settle the point.

Fundulus antillarum, described recently by Fowler, is probably identical with *fonticola*. The type as described and figured seems quite similar to *bermudae*, but is more extensively spotted.

³ Mem. Mus. Comp. Zool., 19, 1895, p. 96.

⁴ Rept. U. S. Comm. Fish., 1896 (1897), p. 241.

⁵ Publ. Field Mus. (Zool.), 5, 1904, p. 106; other specimens of the same lot have been referred to *F. pallidus* by Regan (Biol. Centr.-Am., Pisces, 1907, p. 79).

⁶ See for instance: Regan, Biol. Centr.-Am., Pisces, 1907, p. 79; Jordan and Snyder, Bull. U. S. Fish Comm., 1899 (1900), p. 126 (material re-examined).

⁷ Bull. U. S. Fish Comm., 1901 (1902), p. 149.

⁸ Bull. Mus. Comp. Zool., 50, 1906, p. 156.

6c. *Fundulus heteroclitus bermudae* Günther

The material of the Bermuda *Fundulus* here recorded is that reported by Tarleton H. Bean.⁹

This island race resembles typical *heteroclitus*, rather than *grandis*, in the height of the anal fin. From *heteroclitus* it usually differs in having a slenderer caudal peduncle, the depth of which is less than or only equal to, instead of longer than the postorbital length of the head, excluding the opercular membrane. The males are colored like the most ornate of *heteroclitus*, as described by Garman. The dorsal ocellus is constantly present, surrounded by white spots. The body of the young is crossed by narrow bands, dark in females, light in males (these bars usually less distinct than in the young of *grandis*). In either sex, most of the scales may be marked with white spots.

Dorsal, 12, or sometimes 11, but probably never 14 as counted by Günther in the type; anal, 10 or 11 (last ray counted as divided to base); scales in 31 to 36 series from gill slit to caudal base. Length of head in adult, 2.8 to 3.4 in total length.

Specimens from St. David's Island are quite different in general appearance from those taken at Paget East. The dorsal fins in the males from the former locality are larger than in those from Paget East, and are covered with nuptial tubercles, and are darker in color, less spotted, and have a lighter border. The light bars of the young are persistent in the adult. The females have the genital tube on the anal fin more instead of less than two-thirds as high as the fin. The differences lie in the sexual characters, the St. David's Island specimens appearing in breeding colors and fin development. Those of the other lot, however, were taken on August 20 and September 10, while those from St. David's Id. were collected on September 29. The possibility is not excluded that we have here two species differing in the development of the sexual features.

6d. *Fundulus heteroclitus heteroclitus* Linnaeus

A young male specimen of *Fundulus heteroclitus* 32 mm. long to caudal, collected by T. L. Hankinson in the ocean at Pablo Beach, northern Florida, appears referable to the typical subspecies. The anal fin is quite high, its height being contained 1.4 times in the length of the head. Evermann and Kendall¹⁰ refer all Florida records to *F. grandis*.

6e. *Fundulus heteroclitus macrolepidotus* Walbaum

More thorough study is required before the validity of the several subspecies of *Fundulus heteroclitus* can be regarded as well established.

⁹ Publ. Field Mus., Zool., 7, 1906, p. 35.

¹⁰ Rept. U. S. Comm. Fish., 1899, p. 58.

7. *Fundulus ocellaris* Jordan and Gilbert

The anal pouch of the female is scarcely produced along the front of the anal fin in this or any of the following species of *Fundulus*.

A pair from Louisiana, collected by Weed and Viosca in Bayou St. John, New Orleans, agree in coloration with the descriptions of Louisiana specimens. Another female from Louisiana, 35 mm. long, shows a color pattern intermediate between that of Florida and Louisiana specimens as described.

8. *Fundulus majalis* Walbaum

A pair was collected by Hankinson at Pablo Beach, northeastern Florida.

9. *Fundulus similis* Baird and Girard

Specimens of this species have been examined from Punta Rassa, Fort Myers, Captive Pass and elsewhere in Florida.

The recorded range of this species is to be restricted at both ends, the records from Mexico and from Pelican Island off the east coast of Florida being based on *Fundulus heteroclitus grandis* (which see). The confusion of the species has been caused by the fact that young specimens of *grandis*, as those erroneously identified as *similis*, are marked by conspicuous cross bands. The young of the two species are very easily distinguished by the shape of the snout and the size of the eye.

10. *Fundulus diaphanus menona* Jordan and Copeland

Meek confused *Fundulus* (= *Plancterus*) *zebrinus* with this species. Specimens collected by him at Clear Lake and Estherville, Iowa; at Sioux Falls, South Dakota and in Cedar River, at Austin, Minnesota, all identified as *zebrinus*, prove on re-examination to be referable to the present form. The Clear Lake specimens were recorded by Meek,¹¹ while others reported from Sioux City, South Dakota (*l. c.*, p. 246), are doubtless *F. d. menona*, like those I have seen from the same stream at Sioux Falls. The Austin specimens have apparently not been recorded, and in the paper cited no reference is made to specimens from Estherville. It is probable that other Iowa records of *zebrinus* by Meek refer to *menona*: these are, Fort Dodge (*l. c.*, p. 224), Belmont (p. 229), Dumont (p. 235) and Silver Lake (p. 247).

I hope to carry on studies on the relationship of this form to the typical subspecies of the Atlantic coastwise streams.

¹¹ Bull. U. S. Fish Comm., 1890 (1892), p. 237.

11. *Fundulus catenatus* Storer

Among the specimens of this species which have been examined are several collected by W. J. Clench in Missouri, 6 miles south of Potosi, and 2 miles south of De Soto, and in Kentucky, in Forbush Creek, a tributary of Cumberland River, and South Fork Creek, two and one-half miles northeast of Dunnville.

When received, fresh in formaldehyde, the Missouri specimens, which were mature, showed the following colors: In the males the scale rows were marked by regular series of orange-red spots, one to each scale, becoming indistinct on the amber belly, but brightest on the sides of the abdomen; present also on the sides of the head, being particularly prominent on the opercle; conspicuous also on the basal half of the membranes between the dorsal rays; remaining as merely dusky streaks on the back before the dorsal fin. Dorsal and ventral surfaces of the head dusky; opercles dusky, but cheeks flushed with orange. Vertical bars of body abbreviated and pale, or obsolescent; no scattered black spots on body. Mid-dorsal streak obsolete except for a prominent blackish mark of ob lanceolate form located before the dorsal fin, and a blackish dash before the caudal fin. Dorsal fin pale dusky, lightest on upper anterior corner; lower fins pale dusky; caudal dusky, with a pale margin just outside the subterminal black band.

In the females the body was much more plainly and more lightly colored than in the male, the general tone being pale yellowish brown, countershaded. The rows of orange spots were replaced by rows of brownish black dashes; upper sides marked with irregularly spaced deep brown spots and blotches. Vertical bars confined to middle of sides, and pale, but better developed than in male. Upper but not lower surface of head dusky. Median fins paler than in male, the paired fins clear; caudal without subterminal black band.

12. *Fundulus sciadicus* Cope

Fundulus sciadicus Cope, Proc. Acad. Nat. Sci. Phila., 1865, pp. 78 and 316; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 654; Evermann and Cox, Rept. U. S. Comm. Fish., 1894 (1896), p. 416; Jordan and Evermann, *l.c.*, pt. 3, 1898, p. 2828.

Zygonectes sciadicus Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 122, pl. 2, fig. 1.

Haplochilus floripinnis Cope, Proc. Am. Phil. Soc., 1874, p. 138; Cope and Yarrow, Wheeler Surv., 5, Zool., 1875 (1876), p. 695, pl. 28, fig. 4.

Fundulus floripinnis Jordan and Evermann, *l.c.*, 1896, p. 651; Ellis, Univ. Colo. Studies, 11, 1914, p. 89, fig. 47.

Zygonectes lineatus Garman, Bull. Mus. Comp. Zool., 8, 1881, p. 88.

Fundulus lineatus Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 649.

Zygonectes macdonaldi Meek, Bull. U. S. Fish Comm., 9, 1889 (1891), p. 122, pl. 42, fig. 1.

Fundulus macdonaldi Jordan and Evermann, *l.c.*, 1896, p. 651; pt. 4, 1900, p. 3255, pl. 106, fig. 283.

Garman has synonymized the four nominal species listed above, but other authors have held them distinct. We have compared specimens representing *floripinnis* and *macdonaldi* and find no differences; furthermore they agree well with the descriptions of *lineatus* and *sciadicus*. The species appears to be limited to the Missouri River system, *Fundulus albolineatus* of the Alabama basin probably being distinct.

Scales, 34 to 41; anal rays, 12 to 14; eye, 3.6 to 5.3.

F. sciadicus differs from the next species, *F. jenkinsi*, in the higher number of scales and the smaller eye, and in coloration.

13. *Fundulus jenkinsi* Evermann

Fundulus jenkinsi Evermann, Bull. U. S. Fish Comm., 11, 1891 (1892), p. 86, pl. 36; Evermann and Kendall, *ibidem*, 12, 1892, p. 107, pl. 24; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 651; pt. 4, 1900, p. 3255, pl. 116, fig. 284.

Zygonectes jenkinsii Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 123.

This species was described from Texas by Evermann, and later recorded from "Alabama to Texas" by Garman. A typical specimen collected in East Marsh Lagoon, Prevost Island, St. Tammany Parish, Louisiana, by Weed and Viosea, corresponds finely with the original account, but shows no large black spots.

14. *Fundulus chrysotus* Günther

Zygonectes chrysotus Putnam, Bull. Mus. Comp. Zool., 1, 1863, p. 13 (*nomen nudum*; first description given by Günther, 1866); Jordan and Gilbert, Bull. U. S. Nat. Mus., 16, 1883, p. 342 (description); Henshall, Bull. U. S. Fish Comm., 9, 1891, p. 374; 10, 1892, p. 301, pl. 53, fig. 1.

Haplochilus chrysotus Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 317 (first description).

Micristius chrysotus Gill, Rept. U. S. Comm. Fish., 1871-1872 (1873), p. 809.

Fundulus chrysotus Jordan and Evermann, Bull. U. S. Nat. Mus., No. 47, pt. 1, 1896, p. 655; pt. 4, 1900, pl. 107, fig. 287; Evermann and Kendall, Rept. U. S. Comm. Fish., 1899, p. 59.

Gambusia arlingtonia Goode and Bean, Proc. U. S. Nat. Mus., 2, 1879, p. 118 (original description); Jordan and Gilbert, Bull. U. S. Nat. Mus., 16, 1883, p. 345.

Fundulus arlingtonius, Jordan and Evermann, Bull. U. S. Nat. Mus., No. 47, pt. 1, 1896, p. 652.

Zygonectes henshalli Jordan, Proc. U. S. Nat. Mus., 2, 1879, p. 237 (original description); 3, 1880, p. 21; 7, 1884, p. 322; Chandler, *ibidem*, 59, 1921, p. 658.

Zygonectes cingulatus Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 119 (in part: *chrysotus* and *cingulatus* confounded).

Fundulus scartes Meek, Bull. U. S. Fish Comm., 15, 1895, p. 347 (original description, rather obscure and generally overlooked).

This species ranges from Florida, where it abounds, northward to South Carolina and westward to Texas, Arkansas and Missouri.

The material examined comprises the types of *scartes* from Missouri and Arkansas, which on re-examination were found to agree completely with *chryсотus*; series from Louisiana (ditch near Bayou St. John, New Orleans; Lugger Landing, West Pearl R.; Swamp Pools, Deer Id., Starling, St. Tammany Parish); specimens from Richland, from Lake City, and from Bivens Arm at Gainesville, Florida.

Heavy black blotches are sometimes developed on either sex, in nature and in aquaria. Such individuals breed true, according to aquarists, the character apparently behaving as a recessive in inheritance.

15. *Fundulus cingulatus* Cuvier and Valenciennes

Fundulus cingulatus Cuvier and Valenciennes, Hist. Nat. Poiss., 18, 1846, p. 197 (original description; types redescribed by Jordan, 1886); Jordan and Evermann, Bull. U. S. Nat. Mus., No. 47, pt. 1, 1896, p. 656 (description); pt. 3, 1898, p. 2829; Evermann and Kendall, Rept. U. S. Comm. Fish., 1899, p. 59.

Zygonectes cingulatus Jordan, Proc. U. S. Nat. Mus., 9, 1886, p. 527 (type redescribed); Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 119 (in part: *chryсотus* confused with this species).

Zygonectes rubrifrons Jordan, Proc. U. S. Nat. Mus., 2, 1879, p. 237 (type description); 3, 1880, p. 20.

Fundulus rubrifrons Jordan and Evermann, Bull. U. S. Nat. Mus., No. 47, pt. 1, 1896, p. 653.

Zygonectes auroguttatus Hay, Proc. U. S. Nat. Mus., 8, 1885, p. 556 (type description).

Although very similar to *chryсотus*, this species is distinguished by a number of characters. The anal rays number, counting the last as branched, 9 (rarely 8 or 10), instead of 10 (rarely 9, sometimes 11). The head is heavier; the muzzle more broadly rounded. The fish apparently does not attain so large a size as does *chryсотus*, and the coloration is different in each sex.

Live males collected in stagnant pools at Haines City, Florida, and seen in the aquaria of Mr. H. W. Keedy in Chicago, were colored in the fashion described below. Anterior parts of body dusky olive, with a dark spot just above the pectoral. Posteriorly, a blackish spot, overlaid with orange, at the base of each scale. The orange color diffused over the caudal peduncle and on all the fins, becoming brightest toward the tips of the vertical fins. A row of fine orange-red spots developed along anal fin near base; a similar row of reddish black spots evident on dorsal fin near base. Dark bars on body narrow and barely distinguishable. Chin orange.

16. *Fundulus dispar* Agassiz

Specimens of this species from St. Francis River near Big Bay, Arkansas, were erroneously referred by Meek¹² to *Zygonectes guttatus*.

17. *Fundulus notti* Agassiz

In addition to material already recorded specimens from Haines City, Lake City and from Bivens Arm at Gainesville, Florida, have been examined.

A pair of specimens from Florida, examined alive in a Chicago aquarium, showed rather unusual colors. The male was marked with longitudinal lines broken into dashes. The female was so extremely pale as almost to suggest a black-eyed albino, the lengthwise streaks being barely apparent. According to the aquarium keeper, however, the female brought out at times much darker colors, with the pattern distinct.

18. *Fundulus guttatus* Agassiz

Mr. Weed has sent for examination specimens agreeing with the current descriptions of *guttatus*, and with the types of *Z. escambiae*. These were collected by himself and Mr. Viosea between Bush and Talisheek, Louisiana.

Specimens of *F. dispar* from Arkansas, as indicated above, have been misidentified as *guttatus*.

The range of this species and its relationship with *F. notti* are in need of definition.

Genus 7. *Oxyzygonectes* Fowler

Oxyzygonectes was originally proposed by Fowler¹³ as a subgenus, but Myers¹⁴ has lately proposed that it be accepted as a valid genus. The subgenus or genus is based on *Haplochilus dovi* Günther, a peculiar species from the Pacific Coast of Costa Rica.

Head flat, greatly depressed, and produced anteriorly; the jaws forming a semicircular curve and bearing rather wide bands of villiform teeth. Dorsal and anal fins quadrate in outline, with the posterior angle sharp. Origin of dorsal located above end of anal base. A membranous pouch, containing the urogenital opening, developed about the front of the anal fin of the female.

¹² Bull. U. S. Fish Comm., 1895 (1896), p. 347.

¹³ Proc. Acad. Nat. Sci. Phila., 68, 1916, p. 425.

¹⁴ Am. Mus. Nov., No. 116, 1924, p. 7.

Oxyzygonectes shows a high resemblance to *Panchax* and other Old World cyprinodonts, but it differs from all of these in the development of the pouch about the urogenital opening in the female. This character allies the genus with *Fundulus*, *Lucania* and *Plancterus*.

19. *Oxyzygonectes dovii* Günther

Haplocheilichthys dovii Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 316 (original description); Trans. Zool. Soc. London, 6, 1868, p. 481, pl. 82, fig. 5 (type description amplified); Jordan, Proc. U. S. Nat. Mus., 8, 1886, p. 368; Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 133; Meek, Publ. Field Mus. Zool., 10, 1914, p. 109.

Zygonectes dovii Eigenmann, Proc. U. S. Nat. Mus., 16, 1893, p. 56.

Fundulus dovii Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 650; Regan, Biol. Centr.-Am., Pisces, 1907, p. 80; Fowler, Proc. Acad. Nat. Sci. Phila., 68, 1916, p. 426; Copeia, No. 39, 1917, p. 3.

Aplocheilichthys dovii Jordan and Evermann, Bull. U. S. Nat. Mus., No. 47, pt. 3, 1898, p. 2828; Eigenmann, Rept. Princeton Univ. Exp. Patagonia, 3, pt. 4, 1910, p. 454.

Oxyzygonectes dovii Myers, Am. Mus. Nov., No. 116, 1924, p. 7; The Fish Culturist, 4, 1925, p. 370.

I have examined three series of specimens collected by Dr. Anastasio Alfaro in Costa Rica: 5 from Rio Canas, near Taboga; 2 from pools in the estero near Tivives, and 8 from Brazo Seco.

Genus 8. *Plancterus* Garman

The subgenus *Plancterus*¹⁵ is so sharply characterized by structural features that it should, in our opinion, stand as a distinct genus. *Plancterus* resembles *Fundulus* in most respects, differing in that the alimentary canal is longer and extensively convoluted, and scarcely differentiated into stomach and intestine; the pharyngeal teeth are weaker and slenderer; the gill-membranes are united to the shoulder girdle at or scarcely above the upper end of the pectoral base, rather than being free to the angle of the opercle. This group contains two species (or subspecies), not one as generally supposed.

20. *Plancterus zebra* Girard

Hydrargyra zebra Girard, Proc. Acad. Nat. Sci., 1859, p. 60; Jordan, Bull. U. S. Geol. Surv. Terr., 1878, p. 664.

Fundulus zebra Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 324; Jordan and Gilbert, Bull. U. S. Nat. Mus., 16, 1883, p. 333.

Fundulus adinia Jordan and Gilbert, *l.c.*, 1883, p. 335.

Fundulus zebrinus Jordan and Gilbert, *l.c.*, 1883, p. 891 (substitute for *H. zebra*, preoccupied in *Fundulus*).

¹⁵ Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 96; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 3, 1898, p. 2828.

Approximately topotypic material of *P. zebra* from New Mexico (south of Roswell; Sulphur Spring, south of Sulphur Lake; north of Hondo), has been recently received from the University of Colorado. This material shows that the species ordinarily called *zebra* or *zebrinus*, from the Plains region, is distinct and therefore to be known as *P. kansae* Garman; the true *zebra* is the species currently known as *Fundulus adinia*.

Plancterus zebra has decidedly larger scales than *P. kansae*, in 41 to 49 rows instead of 52 to 64, and a more robust body and larger eye. However, the material strongly suggests the possibility of the intergradation of the two types.

21. *Plancterus kansae* Garman

Fundulus zebrinus Gilbert, Bull. Washburn Lab. Nat. Hist., 1, 1884, p. 15; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 646; pt. 3, 1898, p. 2828; Ellis, Univ. Colo. Studies, 11, 1914, p. 87, figs. 44, 45 and 46 (and of other authors).

Fundulus kansae Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 103.

Several lots of specimens identified by Meek as *zebrinus* are not that species, nor this one, but *F. diaphanus* (which see).

I have examined specimens of *P. kansae* from Wichita, from Winfield, from a permanent spring east of Lerado, from the Arkansas River near the entrance of the Ninnescah, from Brush Creek near Geary in Doniphan County, and from the Great Salt Marsh in Stafford County, all in Kansas; from Alva, from the Canadian River at Norman, and from Wichita National Forest (in Paynes Springs tributary to Cache Creek 8 miles northwest of Cache, about Time O'Day Springs and 9 miles northwest of headquarters), all in Oklahoma; from Spring Creek at Creswell, Texas, and from the following localities in Colorado: Coal Creek, Lafayette, Boulder County; Arikaree River, Beecher's Island, Yuma County; Rock Creek, Louisville Junction, Boulder County; South Platte River, Julesburg; Republican River, Wray; Lodgepole Creek, near Ovid.

The males of this species possess small slender contact organs, hooked forward, on the anal fin and adjacent portion of the body. The pelvic and anal fins in the male are red, and the lower part of the pectoral fin and the margin of the opercle show a trace of the same color.

Subfamily 2. CYPRINODONTIDAE

This subfamily, comprising only a few genera, is characterized by the tricuspid, uniserial teeth and by the elongate intestine. It can not be defined, following Regan,¹⁶ on the basis of the lack of the parietal bone, for we find this bone present in *Cyprinodon bovinus* and in *Floridichthys*

¹⁶ Ann. Mag. Nat. Hist., 7, 1911, p. 323.

carpio, occupying in these species the same position as in *Fundulus*, *Luca-*
nia and *Goodea*.¹⁷ Other skeletal features, however, such as those pointed
out by Starks,¹⁸ may prove to distinguish the Cyprinodontinae from the
Fundulinae.

Three genera of cyprinodontines may be recognized in American waters,
all of which seem to be separable from the Old World types *Aphanius*¹⁹
and *Tellia*. *Aphanius* has a slenderer body than the American genera, and
Tellia lacks pelvic fins. *Aphanius*, furthermore, has the branchial aper-
ture little restricted above, thus differing from *Cyprinodon* although agree-
ing with *Floridichthys* and *Jordanella*.

One American fish referred to *Cyprinodon*, namely *C. amazona*,²⁰ proves
on re-examination by the present writer and by Dr. Eigenmann to be re-
ferable to the characin genus *Nannostomus*.

Another American species, *Cyprinodon martae* Steindachner,²¹ is de-
scribed as having a relatively slender body. I have never seen this fish,
and am uncertain as to what genus it may be referred.

The three American genera may be contrasted in the following manner:

- a¹.—Humeral scale little enlarged. Branchial aperture less restricted. Sexual differ-
ences less pronounced: body not becoming excessively deep, the dorsal fin not
very high nor the scales ciliate in the adult males.
- b¹.—Dorsal fin with about 11 rays, all moderately robust.....9. *Floridichthys*
b².—Dorsal fin with about 16 rays, all but the thickened first ray being slenderer than
usual10. *Jordanella*
- a².—Humeral scale notably enlarged. Branchial aperture restricted almost entirely to
the area below the upper edge of the pectoral base. Sexual dimorphism pro-
nounced: body becoming excessively deep, the dorsal fin very high and the scales
ciliate in the adult males.....11. *Cyprinodon*

Genus 9. *Floridichthys*, new genus

Type, *Cyprinodon mydrus* Goode and Bean (= *Cyprinodon carpio*
Günther).

Cyprinodon carpio differs so trenchantly from *C. variegatus* and its
allies that a new genus is required for its sole reception. It appears to be
quite as closely related to *Jordanella* as to typical *Cyprinodon*.

The humeral scale in *Floridichthys* is scarcely enlarged. The branchial
aperture, as in *Aphanius*, is free to a point about midway between the pec-

¹⁷ *Loc. cit.*, p. 325, pl. 8.

¹⁸ *Biol. Bull.*, 7, 1904, pp. 259-260.

¹⁹ A discussion of the status of this name, which is equivalent to *Lebias* of authors
and to *Micromugil* of Gulia, is given by Jordan in *The Genera of Fishes*, pt. 1, 1917;
p. 121.

²⁰ Eigenmann, *Ann. N. Y. Acad.*, 7, 1894, p. 627.

²¹ *Sitz. Akad. Wiss. Wien*, 72, 1875, p. 60.

toral base and opercular angle. The body does not become excessively elevated, the dorsal fin greatly enlarged, nor the scales ciliate, in the adult male.

(*Floridichthys*: named for Florida, to which state this monotypic genus appears to be wholly confined.)

22. *Floridichthys carpio* Günther

Günther's description of *carpio* seems quite adequate for the purpose of identification. Therefore we can not concur with Fowler²² in adopting Goode and Bean's subsequent name *mydrus* for this species.

I wish to record material from Golden Key, Punta Rassa, Boca Grande, Captiva Pass, Medina Peninsula, and Tarpon Bay on Sanibel Island, all in Florida.

Genus 10. *Jordanella* Goode and Bean

23. *Jordanella floridae* Goode and Bean

New records: Fort Lauderdale, Sanford and Bivens Arm at Gainesville, all in Florida.

Genus 11. *Cyprinodon* Lacépède

The writer is preparing a revision of the numerous species of the genus *Cyprinodon* as here restricted.

Family 2. GOODEIDAE

Subfamily 1. ZOOGONETICINAE

This subfamily was characterized in the first paper of this series.²³ It does not appear to be sharply defined, especially now that we have learned that some of the teeth in *Girardinichthys* are occasionally bicuspid.

Genus 12. *Zoogoneticus* Meek

Zoogoneticus Meek, Publ. Field Mus., (Zool.) 3, 1902, p. 91; 5, 1904, p. 109; Regan, Biol. Centr.-Am., Pisces, 1907, p. 85.

This genus is the least specialized in the family, closely approaching *Profundulus* of the *Cyprinodontidae*. The teeth are simple, conical, in bands; the jaws firmly united; the intestines only moderately elongate.

²² Proc. Acad. Nat. Sci. Phila., 58, 1906, p. 88, fig. 5; 1916, p. 432.

²³ Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 4.

24. *Zoogoneticus dugèsi* Bean

The original spelling of the specific name, as given above, should be retained.

A specimen from Salamanca, Mexico, collected by Dr. Dugès, has been examined.

25. *Zoogoneticus diazi* Meek

Zoogoneticus diazi Meek, Publ. Field Mus., (Zool.) 3, 1902, p. 93, pl. 21 (original description); 5, 1904, p. 114, fig. 32 (description); Regan, Biol. Centr.-Am., Pisces, 1907, p. 86 (description).

Zoogoneticus miniatus Meek, Publ. Field Mus., (Zool.) 3, 1902, p. 94, pl. 21 (original description); 5, 1904, p. 115, fig. 33 (description).

A re-examination of the type material of both these nominal species seems to assure the correctness of Regan's reference of *miniatus* to the synonymy of *diazi*. In the type of *miniatus*, the origin of the dorsal fin lies midway between the caudal base and a point within the posterior third of the opercle, as in paratypes of *diazi*. The proportions of the young from Patzcuaro, paratypes of *diazi*, are the same as those of the type of *miniatus*.

Genus 13. *Girardinichthys* Bleeker

The teeth of the outer row in this genus are excessively variable, being conic, shouldered, truncate and even bifid, all in the same jaw.

26. *Girardinichthys innominatus* Bleeker

Subfamily 2. CHARACODONTINAE

Genus 14. *Characodon* Günther27. *Characodon variatus* Bean

A re-examination of the types of *C. eiseni* Rutter confirms Regan's assumption²⁴ that this nominal species is indistinguishable from *variatus*.

Genus 15. *Lermichthys*, new genus

Type, *Characodon multiradiatus* Meek.

Like *Characodon*, but dorsal and anal fins very much longer, and each composed of more than 25 (instead of fewer than 18) rays. Teeth uniformly and widely bifid.

(*Lermichthys*: named for the Rio Lerma, the highly distinctive fauna of which includes this genus.)

²⁴ Biol. Centr.-Am., Pisces, 1907, p. 89.

28. *Lermichthys multiradiatus* Meek

Girardinichthys innominatus Evermann and Goldsborough, Bull. U. S. Fish Comm., 1902, p. 149 (not of Bleeker; description).

Characodon multiradiatus Meek, Publ. Field Mus., (Zool.) 5, 1904, p. 119; Regan, Biol. Centr.-Am., Pisces, 1907, p. 88, pl. 12, figs. 3, 4.

Genus 16. *Balsadichthys*, new genus

Type, *Goodea whitei* Meek.

Like *Goodea*, but with smaller scales (about 55, instead of fewer than 45 lateral rows), and with the dorsal fin much longer and with decidedly more rays than the anal.

(*Balsadichthys*: named for the Rio Balsas, to the system of which this monotypic genus is confined.)

29. *Balsadichthys whitei* Meek

Goodea whitei Meek, Publ. Field Mus., (Zool.) 5, 1904, p. 137, fig. 40.

Goodea whitii Regan, Biol. Centr.-Am., Pisces, 1907, p. 92.

Genus 17. *Skiffia* Meek30. *Skiffia variegata* Meek

We have very recently remarked²⁵ on the similarity of this nominal species with *S. lermæ*, and indicated that some of the characters on which it was founded are not valid. Examination of additional material seems to show that a slight difference in the depth of the body is correlated with the obvious differences in coloration. On the average the body is more slender in *variegata* than in *lermæ*; the coloration is more conspicuously mottled; the bar at the base of the caudal shows a greater tendency toward horizontal rather than vertical elongation. With these circumstances in view, it seems best to regard *variegata* provisionally as a valid species.

Family 3. POECILIIDAE

Subfamily 1. GAMBUSIINAE

Tribe 1. Gambusiini

The tribe Gambusiini is distinguished from the more primitive members of the tribe Heterandriini, which is referred to the same subfamily, by the possession of certain specialized features of the gonopodium (the modified anal fin or intromittent organ of the male), namely, a small and usually

²⁵ Hubbs, Occ. Pap. Mus. Zool., No. 148, 1924, p. 8.

retorse hook at the extremities of ray 5 and of the posterior branch of ray 4, and a peculiarly thickened node or "elbow" in the anterior fork of ray 4 (see plates). The naturalness of the distinction of these two tribes is confirmed by their geographical relations: the Gambusiini are most abundantly represented in the Antilles and in East-Central Mexico, and range from the Atlantic coast of the United States to Panama, probably but one species occurring south of Mexico; this species, or a representative form, alone occurring on the Pacific slope. The Heterandriini, on the other hand, are prolifically developed on both slopes in Central America and in northwestern South America, only two species occurring in Mexico (*Pseudoxiphophorus bimaculatus* and *Priapella bonita*), and only one, *Heterandria formosa*, farther to the north. The Heterandriini are not represented at all in the Antilles, although they are replaced in Cuba by three genera, *Toxus*, *Glaridichthys* and *Girardinus*, which together constitute a related tribe, the Girardinini.

The Gambusiini and Heterandriini are further distinguished by certain remarkably conservative coloration tendencies, which are of prime importance in allocating specimens in the absence of males with perfect gonopodia. In all but the most primitive of the Gambusiini the pattern consists typically of rows of spots on the body and fins, and a dark suborbital bar is usually evident. In the Heterandriini the pattern is one of cross-hatching, due to dark margining of the scale pockets, coupled with more or less sharply defined vertical bars, which are better developed in the males than in the females, or exclusively represented in that sex, and which present a characteristic appearance easier to recognize than to describe; a dark, suborbital bar is never developed.

In the present paper the Gambusiini are referred to but three genera, although it is realized that several of the groups here recognized within the genus *Gambusia*, particularly those named as subgenera, will probably in time be elevated to generic rank. Of the genera recognized, *Heterophallus* is in many respects the least modified in the structure of the gonopodium, although most extreme in the point of insertion of the dorsal fin. A new subgenus of *Gambusia*, *Heterophallina*, shares some gonopodial characters with *Heterophallus*. The genus *Belonesox* somewhat resembles *Heterophallus* and *Heterophallina* in the structure of the gonopodium, but differs remarkably in the production of the jaws to form a short beak.

In addition to *Heterophallina*, which is composed of the three new species, *Gambusia vittata*, *regani* and *panuco*, two other subgenera, *Arthropallus* and *Schizopallus*, are separated out from the *Gambusia* complex. These two groups comprise the United States species, *G. patruelis* and *G. holbrookii*, which agree in possessing certain highly distinctive features

of the gonopodium (Plate III). In other gonopodial structures these two species are as sharply distinguished from one another, and they too are here separated subgenerically.

As an appendix to my account of the Gambusiini, the synonymy of *Hemixiphophorus gracilis* Heckel is brought together, as this form, when rediscovered, may prove to be related to the species here referred to *Heterophallus* or *Heterophallina*.

An Analysis of the Species of Gambusia and Related Genera

- a¹.—Lower edge of caudal peduncle rounded, with a median series of normal scales. Pelvic fins well developed and alike in the two sexes, inserted behind the base of the pectorals. Rays of the gonopodium not folded together to form a partially enclosed tube, all lying in the same plane; terminal segment of ray 3 of anal fin in the male (the first prolonged ray in the gonopodium) not forming a specialized process; rays 4 and 5 each with a small process, usually retrorsely hooked, at its' extremity; anterior branch of ray 4 with a thickened node or elbow. (Tribe Gambusiini)
- b¹.—Jaws normally formed. Elbow of ray 4 sharply produced; segments of posterior branch of ray 5 enlarged and armed with minute laterally directed spinules, and not extending beyond proximal serrae of ray 4; segments of anterior branch of ray 5 rather slender, and without thorn-shaped incisions (characters of ray 5 not verified for *Heterophallus* and *Heterophallina*) (Plates I to III).
- c¹.—Ray 3 without erect spines and shorter than rays 4 and 5; serrae of ray 4 less modified, and wholly apicad from the elbow; terminal processes of rays 4 and 5 scarcely hooked. Dorsal fin more posteriorly inserted, about twice as distant from eye as from base of caudal in female. A dark lateral band developed in both sexes. *Streams about Vera Cruz, Mexico.* (Genus 18. *Heterophallus*)31. *Heterophallus rachovii*
- c².—Ray 3 with erect spines (the proximal spines not erect in subgenus *Heterophallina*; all the developed spines very short though erect in the subgenera *Arthropallus* and *Schizopallus*); serrae of ray 4 longer and sharper, wholly or in part proximal to, but none distal to the elbow; terminal processes of rays 4 and 5 strongly hooked, except in *Heterophallina* (gonopodial characters of *G. nobilis*, *vittata*, *mcnieli*, *melapleura* and *caymanensis* undescribed) (Plates I to III). Dorsal fin more anteriorly inserted, less than twice as distant from eye as from base of caudal. A dark lateral band developed only in the species of *Heterophallina* and in *G. nobilis*, *senilis* and *affinis*. *New Jersey and Illinois to the Greater Antilles and Panama.* (Genus 19. *Gambusia*)
- d¹.—Terminal processes of rays 4 and 5 small and little modified, scarcely hooked; proximal spines of ray 3 not erect (gonopodium of *G. vittata* not known). Head usually narrower. the mouth with a wider lateral cleft, the jaws sharper: width of head about equal to distance from top of snout to posterior margin of pupil; length of upper jaw equal to or slightly greater than width of mouth. Lateral band blackish, present in both sexes (only in the male of *panuco*); no trace of a dark suborbital bar. *Streams of northeastern Mexico.* (Subgenus 1. *Heterophallina*)

- e¹.—Dorsal rays constantly 8 (counting the last as divided to base). Several scales with conspicuous dark margins, on or near the very distinct blackish lateral band; spots on the body and fins wholly absent; general color yellowish in alcohol. Length of dorsal fin when depressed contained 1.25 to 1.45 times in distance from origin of dorsal to base of caudal. Length of upper lip about one-third its width. *Basin of the Rio Panuco, Mexico*32. *Gambusia vittata* (new species)
- e².—Dorsal rays constantly 7; scales without conspicuous dark edges, but with small spots, as usual in *Gambusia*. *Streams of Tamaulipas and San Luis Potosí, Mexico*.
- f¹.—Serrae of ray 4 wholly proximad to elbow; distal spines of ray 3 little extended beyond hook at tip of ray 4. Caudal and dorsal fins without rows of black spots; spots on body less distinct; a conspicuous lateral band in both sexes, extending from eye to caudal fin (less prominent, however, than in *G. vittata*); general color yellowish brown in alcohol. Length of dorsal fin when depressed contained 1.55 to 1.80 times in distance from origin of dorsal to base of caudal. Length of upper lip one-third its width. *Streams of Tamaulipas, Mexico*33. *Gambusia regani* (new species)
- f².—Serrae of ray 4 opposite elbow distally; distal spines of ray 3 considerably extended beyond hook at tip of ray 4. Caudal and dorsal fins with rows of black spots; spots on the body sharply distinct, but varying in number (as in *G. puncticulata*); lateral band duller, narrow in the male and represented in the female only by a slight diffusion, along the trunk, of dark pigment from the usual blackish streak along the axial septum of the longitudinal muscles; general color brownish in alcohol. Length of dorsal fin when depressed contained 1.25 to 1.45 times in distance from origin of dorsal to base of caudal. Length of upper lip two-fifths its width. *Upper tributaries of the Rio Panuco, San Luis Potosí, Mexico*.....34. *Gambusia panuco* (new species)
- d².—Terminal processes of rays 4 and 5 large and highly modified, strongly hooked; all the well-developed proximal as well as the distal spines of ray 3 erect (gonopodial characters of *G. nobilis*, *meneili*, *melapleura* and *caymanensis* unknown). Head relatively broader, the mouth with a more restricted lateral cleft, the jaws more rounded: width of head about equal to distance from tip of snout to posterior margin of orbit; length of upper jaw less than width of mouth (in these proportions *G. punctata* forms an exception, resembling in these respects the species of *Heterophallina*). A dark suborbital bar usually evident. *New Jersey and Illinois to the Greater Antilles and Panama*.
- g¹.—Spines of ray 3 long and conspicuous; distal hook of ray 4 usually unsegmented, rarely with one incomplete suture, and not much higher than broad; segments of anterior branch of ray 4 anterior to the elbow not coalesced with a ridge-like extension from the elbow; distal-most serra of ray 4 opposite proximal part of elbow (gonopodia of *nobilis*, *meneili*, *melapleura* and *caymanensis* unknown) (Plates I and II). *Southern Texas to Panama; Greater Antilles*. (Subgenus 2. *Gambusia*)
- h¹.—Distal spines of ray 3 projecting far beyond hook at tip of ray 4; length of largest segment, including its spine, about equal to the combined

basal length of all the spine-bearing segments (gonopodium of *G. nobilis* undescribed). A diffuse lateral band extending from eye to base of caudal; anal fin marked with dusky or blackish in female. Dorsal rays usually 8 (7 to 9). *Streams of Texas, New Mexico and northeastern Mexico.*

- i¹.—Mouth with a fairly well developed lateral cleft, in horizontal projection decidedly more than half length of eye. Body robust (least depth of caudal peduncle decidedly greater than half length of head). Dorsal origin more posterior, 1.7 to 1.85 times as far from front of premaxillaries as from base of caudal. Lips pale; suborbital bar well developed in both sexes; streak on lower edge of caudal peduncle narrow and dusky; dorsal and caudal fins with traces only of dusky spots.
- j¹.—Anterior profile slightly convex; interorbital more rounded. Dark marginings of scale pockets more conspicuous, becoming abruptly and strikingly black on the abdomen; sides with the spots more or less obsolescent; base of anal fin and peritroct pale, the fin with some irregular dark blotches or spots. *Streams of northeastern Mexico*35. *Gambusia senilis*
- j².—Anterior profile straight; the interorbital flatter. Dark marginings of scale pockets less prominent, and fading out toward the abdomen; sides marked with fairly definite rows of dusky spots; base of anal fin and peritroct black, this color separated from most of the fin by a definite pale band. *Springs and streams of the Pecos Valley, in New Mexico and western Texas*.....36. *Gambusia nobilis*
- i².—Mouth more nearly transverse, its lateral cleft in horizontal projection decidedly less than half length of eye. Body rather slender (least depth of caudal peduncle about half length of head). Dorsal origin more anterior, 1.55 to 1.7 times as distant from front of premaxillaries as from caudal base. Lips black: suborbital bar absent, or represented by a trace in males only; streak along lower edge of caudal peduncle wider and blacker; dorsal and caudal fins with a variable number of black spots. *Headwaters of the San Antonio—Guadalupe River system of the Gulf drainage in Texas*37. *Gambusia affinis*
- h².—Distal spines of ray 3 projecting little or not at all beyond hook of ray 4; length of largest segment, including the spine, less, usually much less than the combined basal length of all the spine-bearing segments, except in *G. punctata* (gonopodia of *G. mcnieli*, *melapleura* and *caymanensis* undescribed) (Plates I and II). Dusky lateral band very indistinct, or developed only on trunk; anal fin without dark markings. *Streams and lakes from southern Mexico to Panama; Greater Antilles.*
- k¹.—Anal fin falcate in the adults of both sexes. Spots on body usually numerous, often forming more or less uninterrupted rows above the lateral line. Posterior edge of ray 3 obtusely serrate distally, as in *G. punctata*; spinules on anterior margin of ray 3 intermediate in length between those of *punctata* and *puncticulata* (Plate II).

- Atlantic drainage from southern Mexico to Panama*.....
38. *Gambusia nicaraguensis*²⁶
- k².—Anal fin with the edge rounded, straight or slightly emarginate.
Greater Antilles.
- l¹.—Dorsal rays 10 or 11. Back with few or no black spots. *Jamaica*
39. *Gambusia melapleura*
- l².—Dorsal rays 7 to 10 (as many as 10 only in *punctata*). *Greater Antilles.*
- m¹.—Spines of ray 3 very long, the height of largest segment, including its spine, being about equal to basal length of all the spine-bearing segments; the inner edge of these segments strongly produced; terminal hook of ray 4 very broadly rounded at tip; segments between this hook and the serrae very broadly dilated. Dorsal rays 8 to 10. Black spots forming uninterrupted rows on the back. *Streams of Cuba*.....40. *Gambusia punctata*
- m².—Spines of ray 3 much shorter, none of the spine-bearing segments being nearly equal to the combined basal length of all; these segments weakly or not at all produced on the inner edge; terminal hook of ray 4 more or less sharply pointed at tip; segments between this hook and the serrae not broadly dilated (gonopodium of *caymanensis* undescribed) (Plate I). Dorsal rays 7 to 9. Black spots fewer, scattered, not forming definite rows on the back. *Greater Antilles*.²⁷
- n¹.—Dorsal fin inserted above middle of anal base, midway between the opercle and the base of caudal. Length of head, 3 to 3½; depth of body, 3½ to 4. Spots undeveloped (?). *Grand Cayman*41. *Gambusia caymanensis*
- n².—Dorsal fin inserted above posterior part or end of anal base, midway between the base of the pectoral and the caudal base, or nearer the caudal. *Cuba, Haiti and Jamaica.*
- o¹.—Serrae of ray 4 short, only 1 to 1½ times the basal height of each of the serra-bearing segments. Length of head, 3.4 to 4.0; depth of body, 3½ to 4. Usually a few scattered spots. *Jamaica; Haiti.*
- p¹.—Scales 31 to 33 in longitudinal series. *Jamaica.*
- q¹.—Origin of dorsal in female above posterior part of anal, equidistant from base of pectoral and base of caudal; origin of dorsal in male equidistant from middle or posterior part of operculum and base of caudal; longest ray of dorsal in male ¾ length of head. *Jamaica*
42. *Gambusia wrayi*
- q².—Origin of dorsal in female above end of anal, a little nearer to base of caudal than to base of pectoral; dor-

²⁶ Probably related to *nicaraguensis*, and possibly identical with it, but not definitely placeable in the key on account of the lack of males, is a species (*G. mcnieli* Fowler) from the Pacific side of Panama.

²⁷ The species of this Antillean group are in need of further study. I have examined only *oligosticta* and *puncticulata*, and have taken the characters of the other four nominal species from Regan's descriptions and figures.

sal fin of male farther forward and more elevated; origin about equidistant from middle of opercle and base of caudal; longest rays about $\frac{2}{3}$ length of head.

Jamaica43. *Gambusia gracilior*

p².—Scales 28 or 29 in longitudinal series. Origin of dorsal in female nearer base of caudal than base of pectoral; in male equidistant from head and base of caudal. *Haiti*

.....44. *Gambusia dominicensis*

o².—Serrae of ray 4 long, 2 or 3 times the basal height of each of the serra-bearing segments (Plate I).

r¹.—Length of head 3.0 to 3.5; depth of body 2 $\frac{2}{3}$ to 3 $\frac{1}{3}$; top of head usually more concave. Spots on the body usually fewer: often absent, usually about 4, varying from 0 to 11. *Jamaica*45. *Gambusia oligosticta*

r².—Length of head 3.3 to 4.3; depth of body 3.1 to 3.65; top of head usually more nearly straight. Spots on the body usually more numerous and always present, varying from 3 to 20 (usually about 10) in number. *Cuba*.....

.....46. *Gambusia puncticulata*

g².—Spinules of ray 3 short and inconspicuous; distal hook of ray 4 almost always segmented, and more than twice as high as broad; most of the segments of the anterior branch of ray 4 distal to the elbow proper coalesced along anterior edge with a ridge-like extension of the elbow; all serrae of ray 4 entirely proximal to elbow (Plate III). *Atlantic drainage from New Jersey and Illinois south to Florida and to Tampico, Mexico.*

s¹.—Ray 3 unbranched, its posterior edge without denticulations; distal hook of ray 4 usually longer and composed of three to six segments; serrae of ray 4 longer and more retrorse; tip of gonopodium bent more or less sharply forward (Plate III, figures 1 and 2). Dorsal rays typically 6, rarely 7 (6 to 8, usually 7, in a Texas race); anal rays 9, rarely 10. Dark markings usually less distinct, and frequently absent. *Mississippi Valley from Illinois to Texas, and southward along the Gulf drainage as far as Tampico, Mexico.* (Subgenus 3. *Arthropallus*).....

.....47. *Gambusia patruelis*

s².—Ray 3 branched, its posterior edge very sharply denticulated; distal hook of ray 4 usually shorter and composed of but two (one to three) separated segments; serrae of ray 4 shorter and less retrorse; tip of gonopodium straight or bent slightly backward or forward (Plate III, figure 3). Dorsal rays typically 7, rarely 6 or 8 (counting the last as divided from base); anal rays 9 or 10. Spots on the body and fins, the dark suborbital bar, and the dark blotch near the anal base of the female, all usually darker and very seldom absent. *Atlantic drainage of the United States and the adjacent Gulf drainage of Georgia and Florida.* (Subgenus 4. *Schizophallus*).....48. *Gambusia holbrookii*

b².—Jaws produced to form a short beak. Elbow of ray 4 not sharply produced; segments of posterior branch of ray 5 everywhere very slender, nowhere spiniferous, extending beyond all the serrae of ray 4; segments of anterior branch of ray 5 considerably dilated, with thorn-shaped incisions in the thickened wall against

which the segments of ray 5 lie (Plate IV). *Atlantic slope of southern Mexico, Guatemala and British Honduras.* (Genus 20. *Belonesox*).....
49. *Belonesox belizanus*

Genus 18. *Heterophallus* Regan

Heterophallus Regan, Ann. Mag. Nat. Hist., (8) 14, 1914, p. 66.

31. *Heterophallus rachovii* Regan

Heterophallus rachovii Regan, Ann. Mag. Nat. Hist., (8) 14, 1914, p. 66, fig. A.

Genus 19. *Gambusia* Poey

Subgenus 1. *Heterophallina*, new subgenus

Type, *Gambusia regani*, new species.

The species of this subgenus are in some respects intermediate between *Heterophallus* and *Gambusia* in the structure of the anal fin in the male, and are like either *Heterophallus* or *Gambusia* in coloration. The terminal segment of the posterior branch of the fourth anal ray, and the terminal segment of the anterior branch of the fifth ray, are each modified only slightly into a weakly projecting process, as in *Heterophallus* and *Belonesox*; the proximal spines of the third ray are little modified and not erect, also as in *Heterophallus* and *Belonesox*, but the distal spines are well developed and erect, as in *Gambusia* proper; the elbow of the fourth ray is well developed, as in all subgenera and species of *Gambusia*.

The subgenus *Heterophallina* perhaps includes *Gambusia vittata*, known only from females, as well as *Gambusia panuco*, which superficially resembles the species of the typical subgenus *Gambusia*.

(*Heterophallina*: diminutive of *Heterophallus*.)

32. *Gambusia vittata*, new species

Gambusia affinis Meek (not of Baird and Girard), Publ. Field Mus. (Zool.), 5, 1904, p. 130 (in part: the types of *G. vittata*).

Holotype: a mature female 28 mm. long to base of caudal fin, collected May 9, 1903, by S. E. Meek at Forlon, Tamaulipas, Mexico; in the Rio Forlon, tributary to the Panuco. "The Rio Forlon, which at Forlon is a small stream in the dry season, flows over a rocky and gravelly bed" (Meek). The type, and the 12 paratypes, all females (24 to 27 mm. long), were taken with the types of *G. regani*. Five other females are at hand from Valles, having been taken with *G. panuco*. They differ from the type lot a little, particularly in having the top of the head more convex. All are deposited in the Field Museum of Natural History.

Gambusia vittata differs in coloration from all other species of the genus. It is the only species of the Panuco Basin having 8 dorsal rays. Further comparison between these species is made in the analytical key. It is possible that further work will indicate the identity of this species with *Hemixiphophorus gracilis* Heckel.

Body formed more like that of a minnow or a *Fundulus* than that of a typical *Gambusia*, the axis of the body being nearly straight, and both dorsal and ventral contours being evenly curved forward to tip of snout. Greatest depth of body, 3.7 (3.4 to 3.7) in length without caudal; depth of caudal peduncle, 1.7 to 2.1. Head rather deep and broad at base, its length, 3.8 (3.7 to 3.9); interorbital, 2.2 (1.8 to 2.3); top of head rather more convex than usual, especially in the series from Valles; top of snout fleshy, with a pair of longitudinal furrows. Diameter of eye, 2.6 (2.5 to 3.0); length of snout, 2.8 (2.8 to 3.1). Width of gape greater than its length; margin of mandible semicircular in outline; length of upper lip one-third its breadth. Dentition as in related species.

Scales in 31 (30, or rarely 29) rows, 15 or 16 before dorsal.

Color yellowish in alcohol, lighter than in other species. A lateral band extending from upper margin of eye to caudal is very sharply defined, but has uneven borders; scattered scales on and near the band show irregular dark blotches; the pigment of upper sides is concentrated almost wholly in the dark margins of the scales, which become widest toward the mid-dorsal line; a narrow dark band from dorsal to occiput, and a much finer streak along lower edge of caudal peduncle. No suborbital bar. The black blotch about the anus, characteristic of several species of the genus, is wholly lacking in this one; likewise the black spots, so frequently developed on the sides and on the vertical fins of the species of *Gambusia*, are not evident in *G. vittata*, except for a row on the dorsal fin near its base. The margin of the dorsal fin is black or blackish; that of the caudal, dusky to blackish; that of the anal, sometimes dusky.

Fin-rays in constant number, the dorsal with 8, the anal with 10 rays (counting all rays, the last as split to base). Origin of dorsal over end of second third of anal base, midway between end of caudal and corner of gape, its distance from caudal base measured twice forward extending beyond a point a half length of head beyond snout; dorsal flat-topped and pointed posteriorly, its height 1.5 or 1.6 in head. Origin of anal half-way between caudal and posterior part of eye; the height of the fin 1.4 or 1.5 in head; its margin scarcely falcate. Pectoral rather long, 1.2 in head; pelvic reaching to origin of anal.

(*Vittata*: referring to the lateral stripe, which is more prominent in this species than in any other of the genus.)

33. *Gambusia regani*, new species

Gambusia affinis Meek (not of Baird and Girard), Publ. Field Mus., Zool., 5, 1904, p. 130 (in part: the types of *G. regani*).

Holotype: a female 32 mm. long to base of caudal, collected May 9, 1903, at Forlon, Tamaulipas, Mexico; in the Rio Forlon, a tributary of the Rio Panuco. "The Rio Forlon, which at Forlon is a small stream in the dry season, flows over a rocky and gravelly bed" (Meek). Eleven female paratypes, 25 to 32 mm. long, were taken with the holotype and with the single male paratype, a specimen 22 mm. long to caudal. All the specimens are in the Field Museum of Natural History.

Gambusia regani resembles somewhat the other species of the genus from northeastern Mexico, but differs from them in coloration, number of fin-rays, and in details of proportions, as well as in the structure of the anal fin in the male, in which respect it closely resembles *G. panuco* and approaches *Heterophallus rachovii* Regan from Vera Cruz.

Dorsal contour forming a slight double curve before the dorsal; belly distended with eggs; caudal peduncle rather long (measured from end of anal base one third length of fish), with the lower edge horizontal. Greatest depth of body, 4.0 (3.7 to 4.4) in length to caudal; least depth of caudal peduncle, 2.2 (2.1 to 2.3) in head. Head scarcely or not at all compressed, and moderately deep, its contours being nearly continuous with those of the body; length of head, 3.8 (3.65 to 3.85); least interorbital width, 2.3 (2.3 to 2.5); diameter of eye, 3.2 (3.0 to 3.3), length of snout, 3.3 (3.1 to 3.3). Width of cleft of mouth equal to length of snout and decidedly greater than the length of the cleft out to the tip of the lower jaw; median length of upper lip one-third its width; outline of mandible rather broader than semicircular. Teeth conical, in bands, with one outer row of somewhat enlarged teeth.

Scales in 31 (30 to 32) series; 15 to 17 before dorsal.

Color yellowish brown in alcohol, with jaws, top of head, the mid-line of the back and both edges of the caudal peduncle blackish; a dark and prominent lateral band, about as wide as pupil anteriorly, extending with a slight upward curve from upper border of eye to caudal; no suborbital bar; a black paired spot at anus. Edges of scales on back and sides dark, the pigment tending to become concentrated into spots, one on each scale, especially along the scale row bearing the lateral band and the row next above it. Dorsal fin with numerous chromatophores grouped chiefly at base and margin of fin, and in the primary forks of the rays, but not forming definite spots. Caudal fin with two small spots near its base, definitely placed as the basal angles of an isosceles triangle of which the end of the lateral band is the apex; caudal dark distally; anal dusky.

Fin rays: dorsal, constantly 7; anal, constantly 10. Origin of dorsal over end of anal base, midway between end of caudal and front margin of eye, and decidedly less than twice as far from tip of snout as from base of caudal; height of dorsal two-thirds length of head. Origin of anal equidistant from base of caudal and hind margin of eye, varying a little in either direction; anal slightly falcate, its height 1.35 (to 1.5) in head, its margin barely concave. Length of pectoral, 1.3 (or 1.4); pelvic reaching anus.

One male paratype, a specimen 22 mm. long to caudal, was obtained. Depth 4.6 in length without caudal; depth of caudal peduncle, 1.8; length of head, 3.7; width of interorbital, 2.6; diameter of eye, 3.0; length of snout, 3.4; coloration as in female; dorsal, 7; origin of dorsal nearer tip of snout than end of caudal; anal, 10; its origin separated from eye by height of fin, which is contained 3.4 times in the length; the fin behind the produced rays with a rounded margin.

Two female specimens, 25 and 27 mm. long, collected by Dr. Meek in the Rio de Santa Engracia, a tributary of the Rio Sota La Marina, at Santa Engracia, Tamaulipas, Mexico,²⁸ can not be definitely distinguished from *Gambusia regani*, although they differ slightly in coloration and other characters. They may be briefly described as follows:

Length of head, 3.7; depth, 3.6 to 4.0; depth of caudal peduncle, 2.2; interorbital width, 2.5; eye, 3.0; snout, 3.2; scales 32, 16 between dorsal fin and occiput; dorsal rays, 7; anal rays, 10; height of dorsal, 1.7; of anal, 1.4; length of pectoral, 1.3 or 1.4. Color in alcohol light brown; with top of head and muzzle dark; no trace of a dark suborbital bar; a small but conspicuous paired black spot on peritroct; medio-dorsal line before dorsal and both edges of caudal peduncle with a narrow blackish streak; side of body with a distinct, entire, narrow, purplish-brown streak from top of eye to base of caudal, curved upwards on trunk; scales in the row followed by this streak each with a small black spot; scales of the next series above with conspicuous black spots forming a lengthwise series nearly complete on posterior half of body; a few black spots above these; scales of the series below that on which the streak runs, each with a rather small and faint spot, most distinct on scales near middle of body. Caudal fin with a very few spots not forming rows; other fins without spots.

(*Regani*: named for C. Tate Regan, of the British Museum, who, more than any other worker, has brought order into the classification of the poeciliid fishes.)

²⁸ "At Santa Engracia there was but little running water in the river. Above a dam near the railroad bridge the water in the channel was in many places over six feet deep and very clear." (Meek)

34. *Gambusia panuco*, new species

Gambusia affinis Meek (not of Baird and Girard), Publ. Field Mus. (Zool.), 5, 1904, p. 130 (in part: the types of *G. panuco*).

Holotype: a mature female 30 mm. long to base of caudal fin, collected on May 7, 1903, by S. E. Meek at Valles, San Luis Potosí, Mexico: in the Rio Valles, a tributary of the Rio Panuco. "The Rio Valles at Valles is a broad and rather sluggish stream flowing past the city over a rocky bed; for some distance above it is deep and has a muddy bottom." Eight paratypes from the type locality: seven females 22 to 32 mm. long, and a single male of 20 mm. length. All the material referred to is included in the collections of the Field Museum of Natural History.

Gambusia panuco differs in details of coloration and proportions, and in the structure of the intromittent organ, from other species of the genus. It may be distinguished from *G. regani*, of the same river basin, by numerous differences: it lacks the well defined lateral band of that species, but has larger and darker spots on the scales; its general tone of color is darker, in alcohol more brownish; its dorsal and caudal fins are marked by rows of conspicuous spots, which are lacking in *G. regani*. The eye is a little smaller and the snout is more produced than in *G. regani*; the length of the upper lip is about two-fifths instead of one-third its width; the margin of the mandible is semioval, rather than semicircular in outline. Finally, the finer structure of the anal fin in the male offers another point of difference fully as diagnostic, the serrae of the fourth ray being in part opposite instead of wholly proximad to the elbow.

The dorsal contour slopes forward from the origin of the dorsal to the occiput in a gently convex curve, and backward to the caudal fin in a slightly concave curve; the axis of the body is a little elevated at its middle; greatest depth of body, 3.8 (3.4 to 4.2) in length to caudal, varying, of course, with number and size of the eggs; caudal peduncle 1.8 in head. Head little compressed; its contours continuous with those of body; its greatest depth equal to its length to hind border of eye; interorbital width, 2.3 (2.2 to 2.4); length of head, 3.6 (3.4 to 3.8); eye, 3.4 (3.3 to 3.6); snout, 3.0 (2.9 to 3.1). Mouth with developed lateral cleft equal to its length out to tip of mandible, and about equal to length of snout; length of upper lip two-fifths its width; outline of mandible semi-oval. Teeth conical, in a rather broad band; the outer series a little enlarged.

Scales in 30 to 32 series; 16 before dorsal.

Color brown in alcohol; top of head dark; lips dusky; no suborbital bar. A paired black spot about the anus. Mid-dorsal line with a dark streak before dorsal only; lower edge of caudal peduncle with a fine dark line. A very fine blackish axial line along sides of body, and a diffused

indication of a lateral band on trunk. A small and variable number of scales, as in *G. puncticulata*, bear each a black spot, not sufficiently numerous to form apparent lengthwise rows along the middle of the sides, rather faint below axis of body. Upper edge of caudal peduncle with a row of similar spots. Each developed dorsal ray marked with a prominent dark spot near the middle of its height; the fin with indications of a basal and a distal row of spots in addition to this median row. Caudal marked with similarly conspicuous spots, more or less definitely aligned to form three vertical rows. Vertical fins often dusky distally.

Fin rays: dorsal, constantly 7, counting last as split to base; anal, constantly 9, counting the small anterior rays. Origin of dorsal over end of anal base, equidistant from end of middle caudal rays and front margin of eye, or of pupil, as far from base of caudal as from a point one eye diameter behind the upper end of the pectoral base; height of dorsal, 1.4 (to 1.6). Origin of anal equidistant from base of caudal and hind margin of eye; height of anal, 1.3 or 1.4; margin of anal barely concave. Length of pectoral, 1.2 or 1.3; pelvic reaching to origin of anal (or only to anus).

The single male paratype, 20 mm. long, shows the following characteristics. Body slender, its depth 4.4 in length without caudal; depth of caudal peduncle, 1.5. Head shaped as in female, its length 3.8; interorbital width, 2.4; diameter of eye equal to length of snout, 3.3. Color as in female, except that the spots are more numerous, the fine axial line more prominent and the dark pigment more concentrated about it to form a lengthwise streak approaching that of *G. regani*. Dorsal rays 7; origin of dorsal nearer tip of snout than end of caudal; anal, 9, the fin separated from eye by a little more than its height, which is contained 3.4 in body; third, fourth and fifth anal rays forming the intromittent organ; the posterior portion of the fin with a rounded margin.

Three females, 28 to 31 mm. long, collected by Dr. Meek at Rascon, San Luis Potosí, Mexico, in a tributary of the Rio Valles which has a more rapid current and very clear water, differ considerably from the types of *G. panuco* and may even represent a distinct species. As the characters concerned are very variable in the genus, for the present these aberrant individuals may be referred to this species. Head smaller (3.9 to 4.1 in standard length); body rather slenderer (depth of body, 4.1 to 4.3; depth of caudal peduncle, 1.8 to 2.0); interorbital, 2.4; eye, 3.3; snout, 3.3; scales 30 or 31, 17 before dorsal. Dorsal rays, 7; anal, 10; height of dorsal, 1.5; height of anal, 1.3 or 1.4; length of pectoral, 1.35; origin of anal midway between base of caudal and middle of eye. Color in alcohol, light brown; top of head and lips dusky; no trace of a suborbital bar; a paired black spot on peritroct; extremely fine streaks extend between the dorsal fin and the occiput, between the anal fin and the caudal, and

along the axis of the body; a trace of a dusky lateral band on trunk. All of the scale-rows bear interrupted rows of spots, not more than one on each scale, conspicuous above the axis of the body, but faint below it; the row of spots on the scales just above those on which the axial streak runs, is the least interrupted and the most conspicuous, consisting of about 20 developed black spots (about 2 to 12 in the typical material of *G. panuco*). Spots on dorsal and caudal fins smaller and less regularly arranged than in the type lot.

(*Panuco*: named for the Rio Panuco, in the system of which this species occurs.)

Subgenus 2. *Gambusia* Poey

35. *Gambusia senilis* Girard

Gambusia senilis Girard, Proc. Acad. Nat. Sci. Phila., 1859 (1860), p. 122; Regan, Proc. Zool. Soc. London, 1913, p. 985, fig. 168 E.

Gambusia nobilis Woolman, Bull. U. S. Fish Comm., 14, 1894, p. 60; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 682 (exclusive of most of synonymy and range of species).

Gambusia patruelis Garman, Bull. Mus. Comp. Zool., 8, 1881, p. 93 (in part: specimens from Monclova, Mexico).

Gambusia gracilis Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 93 (in part: specimens from Monclova, Mexico).

Gambusia affinis Meek, Publ. Field Mus. (Zool.), 3, 1902, p. 99; 5, 1904, p. 130 (in part: specimens from Sauz, Chihuahua, La Cruz and Garza Valdez).

The range of this species includes the streams of Tamaulipas and Chihuahua, Mexico. It is known from the basins of the Rio Sauz (an isolated stream having the fauna of the Rio Conchos), of the Rio Conchos (a Rio Grande tributary), and of the Rio Sota la Marina (an east coast stream south of the Rio Grande). Specimens from all parts of range agree very closely in coloration, form, fin-ray number (dorsal, 7 to 9) and gonopodial structure.

36. *Gambusia nobilis* Baird and Girard

Heterandria nobilis Baird and Girard, Proc. Acad. Nat. Sci. Phila., 6, 1854, p. 390.

Gambusia nobilis Girard, Rept. U. S. Mex. Bound. Surv., 2, Ichth., 1859, p. 71, pl. 39, fig. 8-11; Proc. Acad. Nat. Sci. Phila., 1859 (1860), p. 120; Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 335.

Although currently synonymized with *G. senilis* of northern Mexico, this species is quite distinct. The anterodorsal profile is straight instead of slightly convex and the interorbital flatter. The coloration is strikingly different. The dark margins of scale pockets are narrower and less conspicuous, and fade out on the abdomen, where in marked contrast the margins become greatly intensified in *senilis*. The sides are marked with

rows of spots, which are scarcely evident or much more scattered in *senilis*. These rows of spots are almost as well developed in *nobilis* as in *punctatus*, being prominent in the axial row of scales, the two rows next above and the next one below the axial series, also along and just behind the bases of the dorsal and anal fins and along the edges of the caudal peduncle. The dorsal and caudal are dusky, the latter with bare traces of spots. The anal fin is strikingly tricolored, the base being black, in continuation with the large black blotch which extends forward to surround the anal opening; a sub-basal bar is pale, apparently yellow or red in life, the outer two-thirds of the fin is deep dusky.

Our specimens of *nobilis*, received from the University of Colorado, were taken at Sulphur Spring, south of Sulphur Lake; North Spring River northwest of Roswell, and from north of Hondo, all in New Mexico.

37. *Gambusia affinis* Baird and Girard

Heterandria affinis Baird and Girard, Proc. Acad. Nat. Sci. Phila., 6, 1854, p. 390.

Gambusia affinis Girard, Rept. U. S. Mex. Bound. Surv., 2, Ichth., 1859, p. 72, pl. 39, fig. 12-15; Proc. Acad. Nat. Sci. Phila., 1859 (1860), p. 120; Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 336. (Not *Gambusia affinis* of later authors.)

Gambusia patruelis Jordan and Gilbert, Proc. U. S. Nat. Mus., 9, 1886, p. 22, (in part).

Gambusia senilis Geiser, Am. Midland Nat., 8, 1923, p. 179, fig. 15-18.

Geiser in 1923 indicated the occurrence in the San Antonio—Guadalupe River system of Texas of a species of *Gambusia* having the very distinctive gonopodial features of *G. senilis*. At my request, he has very kindly collected for us a further series at the same locality (San Marcos), from which had come the material he had recorded. A comparison of these specimens with examples of true *senilis* from Mexico at once shows them to represent a distinct though related species. The distinctive features are indicated in my key.

In addition to this species of the *senilis* type, Geiser collected, at the same locality, the form currently known as *Gambusia affinis*. The discovery here of two species of *Gambusia* has proved of much interest, since Baird and Girard obtained their original material of both *Heterandria affinis* and *H. patruelis* in the same general region (the San Antonio-Guadalupe River system).

A detailed comparison of our material with Girard's figures and descriptions has made it appear almost certain that he had the same two species as we, and therefore that *affinis* and *patruelis* are not synonymous, as is very generally held. The name *patruelis* was obviously based on the weakly-marked local race of the familiar and wide spread species currently called *affinis*. That name, however, was in all probability based on

the species under treatment—one of very local distribution, unknown to most ichthyologists, and related to the Mexican *G. senilis* and apparently also to *G. nobilis* of the Pecos valley. The less angulated form, the absence of a dark suborbital bar, the well defined axial series of spots, the black lips and especially the more anterior position of the dorsal, all features distinguishing the present species from the local type of *patruelis*, are shown in greater or less accuracy in Girard's figure. The more strictly transverse mouth (that of *patruelis* having the lateral gape about as great as in *senilis*) is indistinctly indicated by Girard's figures, and more definitely suggested by the fact that the detailed view of the mouth of *affinis* is shown as from the front, that of *patruelis* as from the side. In other respects, it must be admitted, the original figure of *affinis* does not accurately portray the distinctive coloration of the species with which that name is associated here. A more troublesome discordance involves the number of dorsal rays: Girard gives only 6 rays for *affinis* but 7 for *patruelis*, whereas the form we call *affinis* has 7 or 8 rays, and the local form of *patruelis* more often 6 than 7. It is likely that the numbers were misprinted, the rays miscounted, or the counts transposed.

Our many specimens of the true *affinis* are from the pond at the San Marcos fish hatchery, and the head of San Marcos River, a stream originating in a well-known gigantic spring. Jordan and Gilbert (1886) obviously had both species from the same locality; some of their specimens, which have been re-examined, are true *patruelis*.

38. *Gambusia nicaraguensis* Günther

(Plate II)

Gambusia nicaraguensis Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 336; Trans. Zool. Soc. London, 6, 1868, p. 483, pl. 82, fig. 3; Gill and Bransford, Proc. Acad. Nat. Sci. Phila., 1877, p. 187; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 682; Miller, Bull. Am. Mus. Nat. Hist., 23, 1907, p. 105; Regan, Biol. Centr.-Am., Pisces, 1907, p. 96; Evermann and Goldsborough, Proc. Biol. Soc. Wash., 23, 1910, p. 4; Regan, Proc. Zool. Soc. London, 1913, p. 985, fig. 168A; Fowler, Proc. Acad. Nat. Sci. Phila., 68, 1916, p. 435; Meek and Hildebrand, Publ. Field Mus. (Zool.), 10, 1916, p. 316, fig. 4.

Paragambusia nicaraguensis Meek, Publ. Field Mus. (Zool.), 5, 1904, p. 133; 7, 1907, p. 113.

Gambusia dovii Regan, Proc. Zool. Soc. London, 1913, p. 986.

Gambusia yucataana Regan, Ann. Mag. Nat. Hist., (8) 14, 1914, p. 67, fig. B.

Gambusia dovii Regan was based on a single female 33 mm. long, apparently taken from the type lot of *G. nicaraguensis*. The females of *nicaraguensis* examined in 1913 by Regan were all larger, 40 to 55 mm. long. In a series from Puerto Barrios, Guatemala, are small females with the proportions and form of the anal fin as in *dovii*, and larger ones typical

of *nicaraguensis*. Other specimens are intermediate. Therefore *dovii* is referred to the synonymy of *nicaraguensis*.

Gambusia yucatanana Regan was based on four specimens from Progreso, Yucatan. It was supposed to differ from *nicaraguensis* in the larger head, more anteriorly inserted dorsal fin and in the finer structure of the gonopodium. The differences in proportions are not constant, however, specimens from one locality (as El Hule, Mexico) varying from the one type to the other. As regards the gonopodial characters, our material from southern Mexico and Guatemala agrees with Regan's figure of *yucatanana* better than with his figure of *nicaraguensis*, the latter based on Mexican material. Therefore *yucatanana* is also added to the synonymy of *nicaraguensis*.

As to *G. mcnieli* Fowler,²⁰ I am quite uncertain. It appears from the original account and figure to be closely related to *nicaraguensis*. It is possibly identical with that species; possibly unrelated. The type of *mcnieli* and one specimen doubtfully referred by Meek and Hildebrand to *nicaraguensis*, both females from Panama, represent all the material of *Gambusia* known from the Pacific drainage.

We have a series of *G. nicaraguensis* from Rio Hueyapam at San Juan, a village in Acayucan, Mexico.

39. *Gambusia melapleura* Gosse

“*Poecilia melapleura* Gosse, Sojourn in Jamaica, p. 84, pl. i, fig. 3 (1851).”

Haplocheilichthys melanopleurus Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 317.

Gambusia melapleura Jordan, Proc. U. S. Nat. Mus., 9, 1886 (1887), p. 564; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 3, 1898, p. 2830.

Gambusia melanopleura Garman, Bull. Mus. Comp. Zool., 19, 1895, p. 88; Regan, Proc. Zool. Soc. London, 1913, p. 988.

Fundulus melapleurus Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 659.

Males being undescribed, the classification of this species remains uncertain. It is probably a species of *Gambusia* as here constituted.

40. *Gambusia punctata* Poey

Gambusia punctata Poey, Mem. Mus. Hist. Nat. Cuba, 1, 1885, pp. 384, 390, pl. 32, figs. 5-9; “Repertorio,” 2, 1868, p. 410; Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 334; Intr. Study Fishes, 1880, p. 616, fig. 280; Jordan, Proc. U. S. Nat. Mus., 9, 1886, pp. 34, 564; Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 86, pl. 4, fig. 4; pl. 8, fig. 6; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 679; Eigenmann, Bull. U. S. Fish Comm., 1902 (1903), p. 223; Regan, Proc. Zool. Soc. London, 1913, p. 986, fig. 168D; Fowler, Proc. Acad. Nat. Sci. Phila., 68, 1916, p. 433.

Gambusia punctata punctulata Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 87.

²⁰ Proc. Acad. Nat. Sci. Phila., 68, 1916, p. 433, fig. 5.

This species differs from the other Cuban member of the genus, *Gambusia puncticulata*, in several characters. The body is usually more slender, and less distorted in form. The size attained is larger. The scales are smaller, in 31 to 33 instead of 28 to 30 rows. The coloration is more regular, consisting of from $2\frac{1}{2}$ to 6 even rows of small spots, one on each scale. The dark suborbital bar characteristic of the males, at least, of *puncticulata* and other species, is undeveloped. The dorsal rays are more numerous, 8 to 10, usually 9 (counting the last as split to base), instead of 7 or 8, rarely 9.

The gonopodium is shorter than in *puncticulata*, being contained 3.3 to 3.5 times in the body, instead of about 3 times, as in most species of the genus. Other differences in the finer structure of the intromittent organ are apparent on the comparison of series of males of each species. The spines of ray 3 are very long, the length of the longest segment, including the spine, being about equal to the combined basal length of all the spine-bearing segments. The inner edges of these segments are also conspicuously produced. The terminal hook of the posterior branch of ray 4 is broadly rounded instead of being produced and sharply pointed (but the differences are often less sharp than indicated in Regan's figures). The segments between this hook and the serrae are more broadly dilated and usually fewer than in *puncticulata*, although varying from 3 to 6 in number as in that species; the serrae vary from 4 to 7 in number in each species.

41. *Gambusia caymanensis* Regan

Gambusia caymanensis Regan, Proc. Zool. Soc. London, 1913, p. 990.

This and the following three species are accepted on the authority of Regan, who has described all of them. They are separated in the key by characters taken from Regan's descriptions.

42. *Gambusia wrayi* Regan

Gambusia wrayi Regan, Proc. Zool. Soc. London, 1913, p. 988, pl. 99, figs. 3, 4; text fig. 168B.

43. *Gambusia gracilior* Regan

Gambusia gracilior Regan, Proc. Zool. Soc. London, 1913, p. 989, pl. 99, figs. 5, 6; text fig. 168C.

44. *Gambusia dominicensis* Regan

Gambusia dominicensis Regan, Proc. Zool. Soc. London, 1913, p. 989, pl. 99, fig. 7, text fig. 169C.

45. *Gambusia oligosticta* Regan

Gambusia puncticulata Jordan and Rutter, Proc. Acad. Nat. Sci. Phila., 1897, p. 97 (not of Poey).

Gambusia oligosticta Regan, Proc. Zool. Soc. London, 1913, p. 988, pl. 99, fig. 1, 2; text fig. 169B.

I have re-examined the specimens of this Jamaican species collected by J. Seed Rogers, and recorded as *G. puncticulata* by Jordan and Rutter.

G. oligosticta, so far as can be determined, differs only in average characters from the Cuban species, *G. puncticulata*, and perhaps it will be eventually construed only as an island subspecies. The distinctive features are given in the key.

46. *Gambusia puncticulata* Poey

(Plate I, Figure 1)

Gambusia puncticulata Poey, Mem. Hist. Nat. Cuba, 1, 1855, pp. 386, 389, pl. 31, fig. 6, 7; "Repertorio," 2, 1868, p. 410; Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 334; Jordan, Proc. U. S. Nat. Mus., 9, 1886, p. 564; Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 87, pl. 8, fig. 7; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 680; pt. 3, 1898, p. 2832; Eigenmann, Bull. U. S. Fish Comm., 1902 (1903), p. 223; Nichols, Bull. Am. Mus. Nat. Hist., 31, 1912, pp. 179, 182; Regan, Proc. Zool. Soc. London, 1913, p. 987; Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 24, pl. 1; fig. 1.

Gambusia picturada Poey, "Repertorio," 2, 1868, p. 410.

Gambusia picturata Poey, Ann. Soc. Esp., 5, 1876, p. 141; Jordan, Proc. U. S. Nat. Mus., 9, 1887, p. 564; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 683.

Gambusia nigropunctata Regan, Proc. Zool. Soc. London, 1913, p. 987, fig. 168F.

Gambusia melanosticta Regan, Proc. Zool. Soc. London, 1913, p. 987.

Dorsal rays, 7 to 9 (last double); anal, 9 or 10; scales, 28 to 30.

Depth, 3.1 to 3.65; head, 3.3 to 4.3; eye, 2.6 to 3.2. The mouth is variable in width to an unusual degree, but the variations do not seem to be correlated with other differences, and do not seem to characterize recognizable species or subspecies. For this reason, I do not accept as valid *G. nigropunctata* and *G. melanosticta*, nominal species based largely on this variation.

The structure of the gonopodium is apparently alike in *puncticulata* and *oligosticta*, the four perfect examples of the Jamaican species showing no features not falling within the variations exhibited by the twenty examples of *puncticulata*. Differences are at once apparent, however, when the gonopodia of the two Cuban species are compared, as in Poey's and Regan's figures, and in the present account of *punctata*.

The gonopodium of *puncticulata* (Plate I, Figure 1) is about one-third as long as the fish. The terminal segments of the third ray bear

rather short erect spines, none of the segments being nearly as wide as the combined basal length of the spine-bearing segments; the inner end of these segments is little produced. The hook of the posterior branch of the fourth ray is about as high as wide, and is sharply triangular distally; it sometimes shows one incomplete articulation. The segments between this hook and the 4 to 7 long serrae of the same ray vary from 3 to 6 in number, and are usually more numerous and less dilated than in *punctata*. In the structure of the gonopodium *G. puncticulata* shows a slight approach toward *G. holbrookii* and *G. patruelis*.

In this species the basic pattern of coloration is that of *G. punctata* and other species, each scale bearing one of the spots which together are thus aligned to form lengthwise streaks. Whereas in *punctata* the spots are of subequal size and intensity of color, in *puncticulata* most of them are faint, while a variable number (3 to 20, usually about 10), scattered irregularly over the sides of the body, are black and variously enlarged.

As in *oligosticta*, *holbrookii* and *patruelis*, and other species, the dark pigment in *puncticulata* is more heavily laid down in the males than in the females. In all four cases specified this is especially true of the sub-orbital bar, which is conspicuous in the male, but inconspicuous or obsolete in the female.

In addition to the material reported on by Jordan and by Eigenmann, I have examined series collected by T. L. Hankinson at Cienfuegas, Batabano, and from a small muddy lake at San Antonio de las Vegas, all in Cuba. The specimens from Cienfuegas have the mouth wide; those from San Antonio de las Vegas, the mouth of moderate width; those from Batabano, the mouth relatively narrow.

Subgenus 3. *Arthropallus*, new subgenus

Type, *Heterandria patruelis* Baird and Girard.

This subgenus is characterized by certain peculiar and probably primitive gonopodial characters, as outlined in the key and figured on Plate III.

(*Arthropallus*: in reference to the segmented intromittent organ, particularly to the jointed terminal hook.)

47. *Gambusia patruelis* Baird and Girard

(Plate III, Figures 1 and 2)

Heterandria patruelis Baird and Girard, Proc. Acad. Nat. Sci. Phila., 6, 1854, p. 390.

Gambusia patruelis Girard, Rept. U. S. Mex. Bound. Surv., 2, Ichth., 1859, p. 72, pl. 39, fig. 1-7; Proc. Acad. Nat. Sci. Phila., 1859 (1860), p. 121; Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 84.

Gambusia speciosa Girard, Proc. Acad. Nat. Sci. Phila., 1859 (1860), p. 121.

Gambusia affinis Evermann and Kendall, Bull. U. S. Fish Comm., 1892 (1894), p. 107 (the figures, pl. 25, excepted); Jordan and Evermann, Bull. U. S. Nat. Mus. 47, pt. 1, 1896, p. 680 (in part); Forbes and Richardson, Nat. Hist. Surv. Illinois, 3 ("Fishes of Illinois"), 1908 (Ed. 2, 1920), p. 215, fig. 54; Regan, Proc. Zool. Soc. London, 1913, p. 984 (in part); Fowler, Proc. Acad. Nat. Sci. Phila., 68, 1916, p. 432 (in part); Seale, Philippine Journ. Sci., (D) 12, 1917, p. 177 (fig. 1 excepted); Oshima, Ann. Carn. Mus., 12, 1919, p. 257; Geiser, Am. Midland Nat., 8, 1923, p. 175-187, fig. 6-9, 11-14 (not *Heterandria affinis* Baird and Girard).

Gambusia gracilis Girard, Proc. Acad. Nat. Sci. Phila., 1859 (1860), p. 121 (not *Xiphophorus gracilis* Heckel, possibly also a species of *Gambusia*).

Gambusia humilis Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 335 (substitute for *G. gracilis* Girard).

Zygonectes melanops Jordan, Bull. Illinois Lab. Nat. Hist., 2, 1878, p. 52 (not *Haplochilus melanops* Cope).

Zygonectes brachypterus Cope, Bull. U. S. Nat. Mus., 20, 1880, p. 34.

Zygonectes inurus Jordan and Gilbert, Proc. U. S. Nat. Mus., 5, 1882, p. 143.

Gambusia nobilis Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 682 (synonymy and range in part; not the description).

Gambusia modesta Ahl, Blätter für Aquarien- und Terrarienkunde, 35, 1923, p. 220 (not *Gambusia modesta* Troschel).

Gambusia myersi Ahl, *ibidem*, 36, 1925, p. 42, fig. (substitute name for *G. modesta* Ahl).

This species ranges from southern Indiana and Illinois to the Gulf of Mexico, and along the Gulf Coast from Louisiana to Tampico.

Throughout this range the species exhibits slight variations in color and proportions, specimens from some localities somewhat approaching *holbrookii* in these respects. This is especially true of specimens, topotypic of *patruelis*, from a region in east-central Texas (Comal Creek, New Braunfels and San Marcos). Specimens from these localities also resemble *holbrookii* in the number of dorsal rays (usually 7, often 6, rarely 8), but remain characteristic in the number of anal rays and, more significantly, in the structure of the gonopodium. Specimens from the vicinity of Brownsville, Texas, usually show but 6 dorsal rays.

Specimens from Tampico, topotypic of *G. modesta* Ahl (= *G. myersi* Ahl), seem inseparable from *affinis*, agreeing in fin ray number, coloration and in essential gonopodial structure (Plate III, Figures 1 and 2).

Specimens from Indiana, Missouri, Arkansas, Louisiana, Texas and Mexico agree in possessing the distinctive gonopodial features outlined in the key. According to Geiser, the number of segments bearing serrae on the anterior branch of ray 4, and the number of segments in the terminal hook of the posterior branch of this ray, and the number of spines at the tip of ray 3, are all fewer in the "Central" than in the "Western" race of *patruelis*. Our abundant material shows that at most these are only average differences, possibly of racial significance but not well correlated with definite geographical areas.

The name *Gambusia affinis* has been applied to this species for many years; in fact to both this form and the related though fully distinct *G. holbrookii*. It appears almost certain, however, that the true (original) *affinis* is a species related to the Mexican *G. senilis*, thus belonging to another subgenus of *Gambusia*. The facts in the case are discussed under the head of *Gambusia affinis* (species 37).

Subgenus 4. *Schizophallus*, new subgenus

Type, *Gambusia holbrookii* Girard.

This subgenus differs from *Arthrophallus*, and apparently from all other poeciliid groups, in the branching of ray 3 of the anal fin in the male. It is further distinguished from *Arthrophallus*, with which it agrees much more closely than with any other type, in the sharply denticulated posterior edge of ray 3, and less definitely in other gonopodial characters (see key, and Plate III).

(*Schizophallus*: in reference to the branched rays of the gonopodium, particularly the split third ray.)

48. *Gambusia holbrookii* Girard

(Plate III, Figure 3)

Gambusia holbrookii Girard, Proc. Acad. Nat. Sci. Phila., 1859 (1860), p. 61; Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 334; Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 82, pl. 4, fig. 3; pl. 8, fig. 5; pl. 11, fig. 4-13; Seal, Proc. Biol. Soc. Wash., 24, 1911, p. 91; Regan, Proc. Zool. Soc. London, 1913, p. 983, fig. 169A.

Gambusia holbrookii Geiser, Am. Midland Nat., 8, 1923, p. 175-187, fig. A, 1-5, 10.

Haplochilus melanops Cope, Proc. Am. Phil. Soc., 11, 1870, p. 457.

Zygonectes atrilatus Jordan and Brayton, Bull. U. S. Nat. Mus., 12, 1878, p. 84.

Gambusia affinis Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 680 (in part); pt. 4, 1900, pl. 113, fig. 299a (female; but not fig. 299, male); Kuntz, Bull. U. S. Bur. Fish., 33, 1913 (1914), pp. 181-190, pl. 16-19; Fowler, Proc. Acad. Nat. Sci. Phila., 68, 1916, p. 432 (in part, as of authors generally).

Gambusia patruelis Regan, Proc. Zool. Soc. London, 1913, p. 984 (description only).

Gambusia affinis holbrookii von Harleman, Aquatic Life, 2, 1916-1917 (1917), p. 99, fig.

This well marked form represents *Gambusia patruelis* in the Atlantic Coast drainage (ranging from New Jersey to Florida), and in the adjacent Gulf drainage of Florida and Georgia. The mutual relationships of *holbrookii* and *patruelis* between Georgia and Louisiana are unknown. It is possible that the two forms will be found to intergrade. This possibility is strengthened by a little actual evidence. For instance, specimens from Pensacola, while resembling *holbrookii* in coloration, show an intermediate number of dorsal rays (ten examined having 6, and fifteen, 7 rays); sev-

eral from Black Warrior River in Alabama, otherwise similar, have 6 dorsal rays as in typical *patruelis*. Unfortunately, no males are now at hand from either locality.

The distinctive features of the two species are outlined in the analytical key. They involve the number of fin rays, the finer structure of the gonopodium in the male, and the coloration in the female.

The characteristic coloration of the female, as figured by Jordan and Evermann (1900) and others, is quite constant. The males are more variable in coloration, but also show more black pigment than the males of *patruelis*. In some, the dark markings on the fins are unusually conspicuous, the spots being very large, and the margin of the dorsal fin black. Occasionally the body of the males is more or less completely covered by black blotches, which are disposed in no definite pattern or order. Such specimens occur in nature, and black strains have been bred out by aquarists, and by them erroneously specified as "*Gambusia affinis holbrookii*."

Specimens which appear fully typical of *holbrookii* have been examined from the following localities: Norfolk,* Ocean Grove and Dismal Swamp at Suffolk, Virginia; Little River, Goldsborough and Raleigh, North Carolina; Savanna,* Augusta,* and Buckhead Creek at Millen, Georgia; St. John's River at Welaka,* Myakka River, Gotha, Lake City, Zolfo, Bivens Arm at Gainesville, Lakeland, Haines City, Tampa Bay, Sanford, Fort Lauderdale, Kathleen Mill Creek, Draggan, Charlieapopka, Little River two miles above mouth,* and Alligator River at Punta Gorda,* Florida. Gonopodia have been studied from the several localities marked with an asterisk and found to show no apparent geographical variation.

Genus 20. *Belonesox* Kner

49. *Belonesox belizanus* Kner

(Plate IV)

In addition to the material recorded from Mexico by Meek and from Guatemala by Miller, we have examined specimens in the Field Museum and the Museum of Zoology, from the Rio Hueyapam, below Chicago, Acayucan, Mexico; Belize, Middlesex and Stann Creek (in mangrove swamps) and at 21 Mile station, British Honduras, and from Tela, Honduras.

Genus 21. *Hemixiphophorus* Bleeker

Hemixiphophorus Bleeker, Ichth. Arch. Ind. Prod., 2 (Cypr.), 1862, p. 480.

50. *Hemixiphophorus gracilis* Heckel

Some poeciliid fish from near Orizaba, Mexico, was described by Heckel as *Xiphophorus gracilis*. Garman³⁰ has attempted to apply this name to

³⁰ Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 85.

G. nobilis; Meek³¹ has used it for an entirely different species of the Balsas basin, *Poeciliopsis balsas* Hubbs. I can not agree with either view, and for the time being suggest that *Hemixiphophorus gracilis* be maintained as a doubtful genus and species. Its synonymy follows.

Xiphophorus gracilis Heckel, Sitz. Akad. Wiss. Wien, 1, 1848, p. 300, pl. 9, fig. 3-4.

Gambusia gracilis Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 336 (after Heckel); Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 683 (after Heckel).

Gambusia heckeli Bleeker, Ichth. Arch. Ind. Prod., 2 (Cypr.), 1862, p. 485.

In most respects Heckel's description of *Xiphophorus gracilis* agrees with the specimens here named *Gambusia vittata*, and possibly our species is identical with his. Since the agreement is not perfect, however, and since the types of the respective species came from distinct stream systems with far from identical faunas, we do not feel warranted in making the identification. Unfortunately, the males of *gracilis* possessed only imperfect gonopodia (although all three produced rays are figured as hooked backward distally), and no males of *vittata* are known.

A new expedition into east-central Mexico will be required to obtain the material necessary to fix the status of these species.

Tribe 2. Heterandriini

Genus 22. *Brachyrhaphis* Regan

Brachyrhaphis Regan, Proc. Zool. Soc. London, 1913, p. 997; Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 8.

This genus was based by Regan on *Gambusia rhabdophora*, being characterized by the short and relatively simple gonopodium, of which the second and third produced rays (rays 4 and 5) are bent backward at their tip, and on the *Gambusia*-like mouth and dentition. *Gambusia umbratilis* Meek, which Regan thought related to *B. rhabdophora*, has since been made the type of a very different genus (*Xenophallus* Hubbs, *l.c.*, p. 10).

Under this generic head several species from Costa Rica and Panama which have appeared in the literature under the head of *Gambusia*, *Pseudoxiphophorus* and *Priapichthys* are brought together here.

In several of these species the tip of the gonopodium (which is never flexible as in *Priapichthys*) is not abruptly bent backward at its tip. In the basal length and point of insertion of the dorsal fin the species vary widely, but the extremes are well connected by intermediates.

³¹ Meek, Publ. Field Mus., (Zool.), 3, 1902, p. 99; 5, 1904, p. 130.

51. *Brachyrhaphis terrabensis* Regan

Gambusia terrabensis Regan, Ann. Mag. Nat. Hist., (7) 19, 1907, p. 260; Biol. Centr.-Am., Pisces, 1907, p. 97, pl. 12, fig. 7.

Pseudoxiphophorus terrabensis Regan, Proc. Zool. Soc. London, 1913, p. 993.

Having been known only from females, the generic position of this species has remained uncertain. Principally on account of the high number of dorsal rays, Regan has placed it in *Pseudoxiphophorus*. But the rediscovery of the species shows that it may be referred to *Brachyrhaphis*.

Only the types, collected in Rio Grande de Tèrraba, on the Pacific slope of Costa Rica, have thus far been recorded. Meek's record³² of "Los Cañas, Alajuela, Costa Rica" is erroneous, having been based on specimens of *B. olomina*. Our numerous specimens, representing the young to adult of both sexes (largest male, 38.5 mm. long to caudal; largest female, 51 mm. long) were all collected during February and March, 1923, in the Chiriqui Province of Panama. Series were obtained by Frederick M. and Helen T. Gaige about three miles below Boquete (elevation about 3,600 feet); in stagnant streams about one mile below Boquete (3,700 feet); in an irrigation ditch at Wright Ranch, Boquete, and in a stagnant pool beside Rio Caldera (each at about 3,800 feet), and in a small creek about one mile above Boquete (about 4,000 feet). Still others were collected by Behre and Chambers in Quebrada Sombrero, Quebrada Salao and Quebrada Copera, all in streams tributary to Rio Chiriqui del Tire, Pacific slope of Panama.

The following description of our extensive material is offered as a supplement to Regan's rather brief account.

In the form of the body this fish resembles *Priapichthys annectens* in being little modified toward the surface-swimming type, the axis being scarcely angulated. The dorsal contour is gently convex from snout to dorsal fin, a little more convex from snout to anal fin. The body is quite variable in degree of robustness, the greatest depth being contained 3.45 to 3.65 (3.1 to 3.75)³³ times in the standard length; the least depth of caudal peduncle, 1.75 to 2.1 (1.75 to 2.1) times in head.

The length of the head, from tip of snout to angle of opercular membrane, is contained 3.15 to 3.35 (3.15 to 3.7) times in standard length; length of orbit, 3.4 to 3.7 (3.3 to 3.7) times in head; length of snout, 3.4 to 3.6 (3.3 to 3.7); width of interorbital, 2.25 to 2.5 (2.1 to 2.2); the head wider in the females than in the males, but the dimorphism less sharp than in *Trigonophallus punctifer*; length of upper jaw, 2.8 to 3.2 (2.6 to 3.2).

³² Publ. Field Mus., (Zool.) 7, 1907 (1908), p. 146.

³³ For each character the measurements of the two sexes are separated; those in parentheses are of females. Only adult specimens were measured.

The rounded mandibular tip projects beyond the premaxillaries. The lateral cleft of the mouth is wide, extending decidedly more than half-way to orbit; the maxillary quite reaching vertical from front of orbit; the mandibular margin of the gape forms a semicircle when viewed from below; the upper lip is only about one-eighth as long (on mid-line) as wide.

The teeth are firmly fixed in the jaw bones, and are all sharply conic, and disposed in moderately wide bands. Those of the outer premaxillary series are enlarged and directed downward and forward, but are not widely separated from the band proper; those of the innermost row are also somewhat enlarged. Those of the outer mandibular row are similar to those of the outer premaxillary series, and are directed upward and backward.

Scales in 29 or 30 rows from gill-opening to caudal base.

Dorsal rays, constantly 13 (last divided to base); anal rays, 9; branched caudal rays, 16 to 19.

The dorsal fin is unusually long for a poeciliid fish, longer than in any other excepting *Pseudoxiphophorus bimaculatus*; its base is as long as (or little shorter than) the head. The fin is flat-topped, and pointed posteriorly. The origin of the dorsal is a little nearer tip of snout than end of hypural (or in the smaller females a little nearer the caudal base), and in both sexes lies nearer the vertical from the pelvic insertion than that from the anal origin. The highest dorsal ray is contained 1.7 to 2.35 (1.9 to 2.1) times in head; the middle ray of the truncated caudal fin, 1.4 to 1.65 (1.4 to 1.55); the fourth and longest ray of the slightly rounded, truncate or barely falcate anal fin of the female, 1.75 to 1.9. The pelvic fins are not modified in the male; length, 2.0 to 2.4 (2.35 to 2.5); the second ray is longest. Length of broadly rounded pectoral, 1.55 to 1.6 (1.35 to 1.75).

The gonopodium is short, as in the other species referred to the genus, when depressed falling short of the procurrent caudal rays by a distance contained 1.6 to 2.4 times in the head; its length, measured from origin of fin, is shorter than the head, and is contained 3.4 to 3.7 times in standard length. In finer structure the organ, like those of the other species of *Brachyrhaphis*, is relatively very simple. Ray 3 is greatly thickened, as usual, and does not extend quite to the extreme tip of the following rays; its distal segments are narrowed and irregular, but truncated and never spine-like, on both anterior and posterior edges. The anterior branch of ray 4 is scarcely thickened opposite the serrae; its subterminal segments are slightly irregular, but not spinous on the anterior edge. The developed serrae of the posterior branch are about seven in number. Both of these branches, as well as ray 5, at their extreme tips enter the acuminate and barely retrose tip of the gonopodium. No trace is developed of that

triangular modification of the extreme tip of the organ, which is diagnostic of *Trigonophallus*.

The male is a strikingly colored little fish. The scale pockets are finely but sharply margined with blackish; this color fading out ventrally, especially on the belly. At the angle of each pocket the pigment is expanded to form a more or less distinct spot, or a pair of spots in the case of the scales of the axial series; the pattern so produced, however, is not nearly as sharp as in *Priapichthys annectens*. At frequent intervals along the axial series of scales a small subquadrate dusky blotch is developed, and through each of these a dark brown vertical bar extends. These bars are sharpest posteriorly, fading out on the trunk; medially they extend entirely across the body; there are 9 to 13, usually 11 to 13 bars behind the origin of the dorsal fin. There is a suffusion of dark pigment above and behind the pectoral fin. The sides of the head are dusky to below the eye, darkest behind the upper end of the preopercle. The top of the head and the margins of both jaws are deep dusky; the lower edge of the dark mandibular margin is intensified to form a blackish streak, which is continued straight backward to the lower margin of eye; below this is a pale streak, which surrounds a dusky blotch on the chin. The hair-like streaks along the axial septum and on the edges of the caudal peduncle are usually obsolescent in the adults of this species, that on the lower edge of caudal peduncle occasionally evident. The dorsal fin is marked with a basal and two submedian vertical black dashes, alternating in position on the membranes (three spots between each pair of rays), by reddish color between the dashes, and by a submedian dusky blotch on the posterior edge; the margin of the fin is pale. The color of the caudal fin darkens from the middle of the base outward, producing with the basal bar a dusky hollow square, widest and darkest posteroventrally; the color of the fin then fades to the edges, thus leaving a narrow upper and lower, and a broad posterior, pale margin. The anal fin is marked by a more or less dusky or blackish spot, blotch or bar toward its base posteriorly, and the posterior end of the fin is surrounded on the body by a dusky area more or less produced backward along the lower edge of the caudal peduncle.

In the young as small as 13 mm. the characteristic color markings of the dorsal and caudal fins are hardly in evidence, although they appear soon afterward, but the anal spot is already prominent, being black, and larger than in most adults, and extended onto the body. The pattern consists of an even margining of the scale pockets and of the more or less distinct squarish blotches along the axial scale rows. The fine hair-like streaks along the axial septum and lower edge of caudal peduncle are much better developed than in the adult.

In the adult female the whole scheme of coloration is more diffuse than in the male, the most striking element of the pattern being the dark margining of the scale pockets. The axial blotches are very pale, and the vertical bars can only be made out, with difficulty, and only near the caudal base. The dorsal fin markings are much more diffuse and less definite than in the male. The caudal is often mostly blackish. The anal spot is divided into a dusky blotch on the body near the end of the anal base, and a small blackish spot on the fin. The development of this spot, however, is very variable; in some half-grown females it covers almost the entire fin plus a rather large area on the body. The rest of the fin is sometimes dusky, but never shows the distal blotch described by Regan. The paired fins are more or less dusky in the female, the pectoral being especially dark near its upper edge.

Non-breeding males are intermediate in coloration between the females and the breeding males.

52. *Brachyrhaphis rhabdophora* Regan

Gambusia rhabdophora Regan, Am. Mag. Nat. Hist., (8) 2, 1908, p. 457.

Brachyrhaphis rhabdophora Regan, Proc. Zool. Soc. London, 1913, p. 997, fig. 169D; Meek, Publ. Field Mus., (Zool.) 10, 1914, p. 115.

In this species the dorsal is inserted over, or a little before or a little behind, the origin of the anal.

The anal fin in *rhabdophora* lacks the black spot characteristic of *olomina* and other species. This character, apparently one of the most important features of the species, was not described by Regan. Mr. J. R. Norman has kindly examined the types, and writes—

“The colouration of the anal fin is rather nondescript and distinctly variable. The ground colour in spirits is yellowish, with a number of minute blackish dots variously disposed to a greater or lesser extent over the fin. In most of the specimens these dots are more numerous near the bottom of the fin, and tend to form 3 or 4 dark patches near the bases of the branched rays.”

53. *Brachyrhaphis olomina* Meek

Gambusia terrabensis Meek, Publ. Field Mus., (Zool.) 7, 1907 (1908), p. 146 (not of Regan).

Priapichthys olomina Meek, Publ. Field Mus., (Zool.) 10, 1914, p. 114.

This species, which occurs at various elevations on both slopes of Costa Rica, agrees precisely with Regan's description of *B. rhabdophora* in the finer structure of the gonopodium, as well as in proportions. It may prove inseparable from that species. *B. olomina* is very similar to *B. episcopi* of Panama, but differs, among other respects, in the more anterior insertion

of the dorsal fin, the origin of that fin being only 1.3 to 1.6, instead of 1.7 to 1.9 times as distant from tip of snout as from base of caudal.

The Field Museum possesses three unrecorded series of this species. One lot was collected by Dr. Alfaro at Guacas, near Jesus María; another was obtained by the same collector at Siquiaries, in the basin of the Rio Grande de Tárcoles. Two small males, agreeing well with types of similar size, were obtained at Guapilis. This town, also spelled Guapiles, is on a river of the same name tributary to the Rio Negro, which empties into the Rio Colorado, in the marshy region near the mouth of the Rio San Juan of the Atlantic drainage.

In young specimens of *B. olomina* a series of about twelve vertical bars, each passing across a squarish spot on the axis of the fish, extends from head to caudal. These bars (as well as the black marking of the anal fin) are developed in specimens 10 mm. long to caudal, but gradually become obsolete from before backward. The largest specimens at hand, 50 mm. long, retain no trace of dark spots or bars, the color pattern of the body consisting solely of the blackish cross-hatching of the scales. The scales of the axial series are the lightest in color, forming an indistinct lateral band.

54. *Brachyrhaphis episcopi* Steindachner

Gambusia episcopi Steindachner, Sitz. Akad. Wiss. Wien, 77, 1878, p. 387, pl. 2, fig. 3, 4; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, 1896, p. 683; Regan, Biol. Centr.-Am., Pisces, 1907, p. 96; Evermann and Goldsborough, Proc. Biol. Soc. Wash., 22, 1909, pp. 96, 101, 102; 23, 1910, p. 4; Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1916, p. 317; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 180.

Priapichthys episcopi Regan, Proc. Zool. Soc. London, 1913, p. 992.

Gambusia latipunctata Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1913, p. 87.

The axis of the body in this species is curved, but not sharply angulated.

The anal fin may be falcate in the female of *episcopi*, as also in *B. cascajalensis*.

We have numerous specimens of this Panama species, collected by Dr. W. C. Allee and F. M. Gaige, from an inlet to Gatun Lake, and Barro Colorado Island in that lake, both in the Canal Zone.

55. *Brachyrhaphis cascajalensis* Meek and Hildebrand

Gambusia cascajalensis Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1913, p. 86; 10, 1916, p. 318; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 180.

Material extending the range of this species in both directions is before me. One lot was collected by Mr. David E. Harrower in pools and shallows about two miles upstream from the Caribbean Sea in Rio Nargana, a

stream about fifty feet wide in San Blas, Panama, about 40 miles from Carti toward Colombia.

The other series were obtained by Dr. Elinor Behre on the Caribbean slope of Panama and Costa Rica on each side of the frontier, at the following localities: Shepard Creek, flowing into lower Almirante Bay, and the upper course of Western River and the lower course of Quebrada Nigra, both flowing into Almirante Bay; Fruitdale Creek, along railroad spur back of Almirante, Panama; Guibari Creek below Conquantu, a small right bank tributary below Conquantu, and Nomonuen Creek above Conquantu, all three tributary to Rio Cricamola, Panama; Koi Creek and lower Skoon Creek above Coen, both tributaries of Rio Tilire in the Talamanca Valley of Costa Rica.

In this species the insertion of the dorsal is almost or quite as posterior as the end of the anal base, almost as far back as in *B. parismina*. The axis of the body is sharply angulated.

56. *Brachyrhaphis parismina* Meek

Gambusia parismina Meek, Publ. Field Mus., (Zool.) 10, 1912, p. 71.

Priapichthys parismina Regan, Proc. Zool. Soc. London, 1913, p. 992; Meek, Publ. Field Mus., (Zool.) 10, 1914, p. 113.

In the length and finer structure of the gonopodium, this species agrees essentially with the others here referred to *Brachyrhaphis*.

B. parismina is closely related to *B. cascajalensis*, being distinguished most sharply by the development of a large ocellated blackish spot on the upper base of the caudal fin. The scale pockets are margined with blackish brown, most conspicuously at their margins. Fine blackish lines extend along the axis of the body, on the mid-dorsal line, and on both edges of the caudal peduncle.

Genus 23. *Trigonophallus*, new genus

Type, *Trigonophallus punctifer*, new species.

This new genus is close to both *Priapichthys* and *Brachyrhaphis*, agreeing with them in form of body, dentition, and in the relatively simple structure of the gonopodium. This organ is longer than in *Brachyrhaphis*, being decidedly more than one-third as long as the fish (to caudal fin). The extreme membranous tip is peculiarly hardened and modified into a subtriangular structure, the free tips of which are pointed outward and backward. The distal segments of ray 3, as in neither of the related genera, are produced posteriorly as definite pointed spines. The tips of rays 4 and 5, as in most of the species here referred to *Brachyrhaphis*, are slightly

turned backward. Another point indicating close relationship with the same genus is the development of a black spot on the anal fin of both sexes.

(Trigonophallus: referring to the subtriangular modification of the tip of the intromittent organ.)

57. *Trigonophallus punctifer*, new species

Type: an adult male 30 mm. long, with perfect gonopodium, collected by Behre and Chambers February 23, 1923, in Guibari Creek, a tributary of the Rio Cricamola below Conquantu, on the Caribbean slope of western Panama; Cat. No. 72573, Museum of Zoology, University of Michigan. The paratypes; all females, 27 to 51 mm. long, were obtained by Dr. Behre at four stations; three at the type locality; four in Nomonuen Creek, on the Rio Cricamola above Conquantu, and another in the upper course of Western River, flowing into Almirante Bay, Panama.

The form is modified toward the supernatant type: that is, the axis of the body is angulated near the middle, so that when the flattened anterodorsal contour is horizontal, as when applied against the surface of the water, the tail is bent downward. The dorsal contour is moderately convex from the dorsal fin forward to the occiput, thence almost straight to tip of snout (in old females the contour is evenly depressed near the occiput, then again convex about the eyes). The tip of the snout is very high, particularly in old females. The body is comparatively deep, the greatest depth being contained 3.25 times in the standard length (3.0 to 3.4 times in the female paratypes, the smaller specimens being the slenderer); the caudal peduncle is rather sharply compressed and quite deep, its last depth contained 1.65 (1.6 to 1.9)³⁴ times in the head.

The length of head, measured from tip of snout to edge of membrane at opercular angle, is contained 3.3 (3.4 to 3.7) times in the standard length; length of orbit, 3.0 (2.7 to 3.6, the smaller specimens having relatively the larger eyes) in head; length of snout, 3.5 (3.3 to 3.6); interorbital width, 2.5 (1.9 to 2.1 in females, which are heavier anteriorly than the males); length of upper jaw, 3.35 (2.8 to 3.2).

The symphysial knob of the mandible protrudes beyond the upper jaw. The lateral cleft of the mouth is well developed, extending much more than half-way to the orbit, the maxillary quite reaching the vertical from front of orbit; the mandibular margin of the gape forms a semicircle when viewed from below; the upper lip is only about one-sixth as long (on mid-line) as wide.

The teeth of the jaws are firmly fixed in the bone, and are all sharply conic. They are arranged in bands of moderate width. Those of the outer

³⁴ All measurements in parentheses were made on the female paratypes.

premaxillary series are not widely separated from those of the band proper, but are markedly enlarged along the entire gape, and directed downward and forward. Those of the innermost premaxillary series are also somewhat enlarged. Those of the outer mandibular series are enlarged, and directed backward and upward when the mouth is shut.

Scales in 28 (28 or 29) rows from upper end of gill-opening to end of hypural.

Dorsal rays, 11 (10, rarely 9), counting the last as divided to base; anal rays, 9, counting the small anterior rays; branched caudal rays, 14. The dorsal fin is not far posterior, its origin being nearly an eye's length nearer tip of snout than end of middle caudal rays in the male (equidistant between these two points in the smaller females, a little nearer the end of caudal in the larger ones), almost as near orbit as end of hypural (about midway between caudal base and upper end of gill-opening in smaller females, or slightly nearer caudal base than upper end of pectoral base in older females). The dorsal fin is flat-topped and somewhat pointed posteriorly; the highest ray is contained 1.7 (1.7 to 1.9) times in length of head. The length of the dorsal base is contained 1.5 (1.7 to 1.9) times in the head and is more than half longer than the anal base. The caudal fin is truncate; its middle ray is contained 1.1 (1.05 to 1.2) times in head. The anal fin is inserted about a pupil's diameter farther from end of hypural than the dorsal (the difference usually not quite so great in females).

In the adult male the third to fifth rays are prolonged to form the gonopodium; the outline of the following rays is rounded. (In the females the anal is slightly falcate, the fourth ray being longest, and contained 1.05 to 1.35 times in head.) The pelvic fins are not modified in the male; the second ray is longest; length of fin 1.8 (1.75 to 1.9) in the head. Length of rounded pectoral, 1.35 (1.3 to 1.5).

The gonopodium is elongate, reaching when depressed to within one diameter of pupil from procurvent caudal rays; its length, measured from origin of anal, is contained 2.65 times in the standard length. Ray 3 is greatly thickened, as usual, and does not extend quite to the extreme tip of the organ; the distal segments are produced retrorsely as definite spines on their posterior edges; the spines begin rather abruptly near the middle of the serrae of ray 4, and toward the tip of the ray gradually become shorter, blunter and less retrorse. The anterior branch of ray 4 is gradually thickened opposite the serrae, but the sutures remain transverse, and no structure resembling the elbow of the *Gambusiini* results. The posterior branch of ray 4 bears 8 definite retrorse serrae, not counting five elements marking the transition from the normal elongate segments to the serrae.

Both branches of ray 4 and the fifth ray are bent backward slightly at the extreme tip.

The color in general is pale, with a darker suffusion behind pectorals and on top of head; upper lip blackish, and margin of mandible dusky. The scale-pockets, except on belly, are narrowly and distinctly, but not strikingly, darkened. Many of these margins are intensified at the apex to form a single spot, or a double spot along the axial series; these spots are best developed anteromedially, where they form rather inconspicuous rows. No trace of axial quadrate blotches nor vertical bars are evident, even in our smallest specimens. The fine streaks on the body are poorly developed, that along the axial septum being evident only near the caudal base; that on mid-dorsal line, obsolescent; that on lower edge of caudal peduncle, faint. The dorsal fin is marked by a row of vertically elongate spots on the membranes near the base (these spots often indistinct in females); the outer posterior angle of fin dark. The caudal is dusky, especially toward the margin. The anal fin is marked by a submedian blackish blotch on the rays behind the produced gonopodium (in the female the blotch is triangular, with the base or a detached portion on the body, and the tip extending toward, but not to, the margin behind the sharp tip of the fin).

(*Punctifer*: in allusion to the spots on the body.)

Genus 24. *Priapichthys* Regan

Priapichthys Regan, Proc. Zool. Soc. London, 1913, pp. 979, 990; Meek, Publ. Field Mus., (Zool.) 10, 1914, p. 111; Henn, Ann. Carn. Mus., 10, 1916, p. 115; Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1916, p. 319; Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 8.

Regan, Meek, Henn and Meek and Hildebrand have referred a number of diverse species to this genus. I give below the generic reference of each of these species. Regan apparently had examined the gonopodium of but one species (*annectens*), the type of the genus.

1. Species referred to *Priapichthys* by Regan, 1913, with present generic reference.

<i>Species</i>	<i>Present Reference</i>
1. <i>Gambusia annectens</i> Regan	<i>Priapichthys</i>
2. <i>Gambusia episcopi</i> Steindachner	<i>Brachyrhaphis</i>
3. <i>Gambusia nigroventralis</i> Eigenmann and Henn	<i>Alloheterandria</i>
4. <i>Gambusia parismina</i> Meek	<i>Brachyrhaphis</i>
5. <i>Gambusia tridentiger</i> Garman	<i>Allogambusia</i>
6. <i>Gambusia turrubarensis</i> Meek	<i>Poeciliopsis</i>

2. Meek in 1914, dealing with species number 1, 4 and 6 of the above list, followed Regan in referring them to *Priapichthys*, and described a species of *Brachyrhaphis* as *Priapichthys olomina*.

3. Henn in 1916, also following Regan, referred *Gambusia nigroventralis* (= *Alloheterandria nigroventralis*) to Priapichthys.

4. Species referred to Priapichthys by Meek and Hildebrand in 1916, with present generic reference.

<i>Species</i>	<i>Present Reference</i>
1. <i>Gambusia tridentiger</i> Garman	Allogambusia
2. <i>Gambusia cana</i> Meek and Hildebrand	Allogambusia
3. <i>Gambusia darienensis</i> Meek and Hildebrand	Darienichthys
4. <i>Priapichthys panamensis</i> Meek and Hildebrand	Panamichthys

58. *Priapichthys annectens* Regan

This species is divisible into two subspecies, as I have pointed out in some detail.

58a. *Priapichthys annectens annectens* Regan

Gambusia annectens Regan, Ann. Mag. Nat. Hist., (7) 19, 1907, p. 259; Biol. Centr.-Am., Pisces, 1907, p. 97, pl. 14, figs. 5-7.

Priapichthys annectens Regan, Proc. Zool. Soc. London, 1913, p. 992, fig. 170 B; Meek, Publ. Field Mus., (Zool.) 10, 1914, p. 114 (in part).

Priapichthys annectens annectens Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., 13, 1924, p. 20.

There are at hand two females apparently referable to this subspecies, collected by Behre and Chambers in Skoon Creek, a tributary of Rio Tilire above Coen, Talamanca Valley, Costa Rica, near the Panama border. They differ from specimens hitherto known in showing a black spot on the anal fin near the base, but since the spot is larger in one specimen than in the other, and since the similar spot in the species of *Brachyrhaphis* is subject to great variation in size, we do not feel warranted in separating these specimens as a distinct species on this basis. Furthermore, the development of black pigment on the anal fin in these specimens may have been induced by the presence of a parasite. This appears to be probable in the case of the specimen showing the smaller spot. The other specimen shows a similar spot on one side only of the caudal peduncle, the spot definitely surrounding and following the cyst of a dermal parasite.

These two specimens show the following subspecific characters. Dorsal rays, 10 in one specimen, 11 in the other; head, 3.4; eye, 3.0; mouth rather narrow; spots very sharply developed, one on each scale except on the posterior half of the axial series, where there are two on each scale.

58b. *Priapichthys annectens hesperis* Hubbs

Priapichthys annectens hesperis Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 22.

A single specimen, labelled "Turrúcares, Pacific side, Siquiares," Costa Rica, and thus from a lower elevation than those at which the types were taken, seems to be referable to this subspecies. It is a female 34 mm. long to caudal fin. Dorsal rays, probably 9; head, 3.7; eye, 3.6; pigment of margin of scale pockets concentrated to form short vertical dashes on lower half of sides.

59. *Priapichthys huberi* Fowler

Priapichthys huberi Fowler, Proc. Acad. Nat. Sci. Phila., 75, 1923, p. 27.

Of this species, recently described from Miranda, Nicaragua, I have before me one specimen taken by Messrs. Schmidt and Walters of the Field Museum at Siquatepeque, Honduras, on May 13, 1923, at an elevation of 3,600 feet.

P. huberi differs sharply from *P. annectens* in coloration, and in the more angulated axis of the body. It may belong to a distinct genus. The gonopodium is imperfect in Fowler's type³⁵ and scarcely developed in the specimen at hand.

Genus 25. *Panamichthys* Hubbs60. *Panamichthys panamensis* Meek and Hildebrand

Priapichthys panamensis Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1914, p. 322, fig. 8; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 181.

Panamichthys panamensis Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 8.

The position of the dorsal fin has been misdescribed in this species: it is stated to be midway between the posterior margin of the eye and the base of the caudal, whereas it is really midway between the former point and the end of the caudal fin, as in *Darienichthys dariensis*. This affords an additional character for the separation of *Panamichthys* from *Priapichthys*.

Genus 26. *Pseudoxiphophorus* Bleeker

Pseudoxiphophorus Bleeker, Ichth. Arch. Ind. Prodr., Cypr., 2, 1860, p. 482; Atl. Ichth. Ind. Orient. Néerl., 3, 1863, p. 140; Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 332; Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 80; Jordan and Evermann, Bull. U.

³⁵ The supposed difference in the relative length of the rays in the male anal, used by Fowler to separate the two species, probably has no significance.

S. Nat. Mus., 47, pt. 1, 1896, p. 678; Meek, Publ. Field Mus., (Zool.) 5, 1904, p. 127; Regan, Biol. Centr.-Am., Pisces, 1907, p. 97; Proc. Zool. Soc. London, 1913, p. 993; Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 8.

Poecilioides Steindachner, Sitz. Akad. Wiss. Wien, 48, 1863, p. 176.

61. *Pseudoxiphophorus bimaculatus* Heckel

As usual in the genera of the tribe Heterandriini, one of the principal features in the coloration of this species consists in the dark margining of the scale pockets. In young specimens vertical bars of the type peculiar to the Heterandriini are evident but perhaps never sharply developed. Blackish blotches on the body, in addition to the two usually developed, are occasionally evident.

This species is divisible into a southern-lowland and a northern-mountain subspecies. There is a wide range of areal intergradation between these two types. Partially because the types of *bimaculatus* apparently represent such intergrades, we have recognized *Pseudoxiphophorus bimaculatus bimaculatus* as an intermediate subspecies.

61a. *Pseudoxiphophorus bimaculatus jonesii* Günther

The synonymies of this and the two other subspecies of *Pseudoxiphophorus bimaculatus* are given in an earlier paper of this series.³⁶

In additional material collected by Woolman at Orizaba, Mexico, the dorsal rays vary as indicated below.

Dorsal rays	11	12	13	14
Specimens from Orizaba	1	11	2	1

61b. *Pseudoxiphophorus bimaculatus bimaculatus* Heckel

In additional material collected by Meek in Mexico I count the dorsal rays as follows:

Dorsal rays	12	13	14
Specimens from Jalapa	1	6	2
Specimens from Cordoba	—	1	3

61c. *Pseudoxiphophorus bimaculatus taeniatus* Regan

Fowler has lately recorded³⁷ *Pseudoxiphophorus bimaculatus* from Miranda, Nicaragua, considerably south of any prior record for the species. This reference should apparently be added to the synonymy of *P. m. taeniatus*, the southern subspecies.³⁸

³⁶ Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, pp. 17-19.

³⁷ Fowler, Proc. Acad. Nat. Sci. Phila., 75, 1923, p. 28.

³⁸ Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 18.

In restudying the material of this species recorded by Miller from Guatemala,³⁹ I find no error in specific determination, but no specimen with fewer than 12 dorsal rays.

In this Guatemalan material there are two apparently distinct races represented. One from the vicinities of Puerto Barrios and Amates, at elevations of 0-260 feet, has 13 to 17, most frequently 15 dorsal rays, and the coloration pale. The other, from an irrigation ditch west of Gualan, has 12 to 15, usually 14, dorsal rays, and the coloration dark, approaching that of the type of *taeniatus*. Of the waters about Gualan Miller wrote: "The Rio Motagua is a mountain stream from here to its source . . . Altitude 430 feet." These facts make it seem probable that in Guatemala as well as in Mexico (see Hubbs, 1924, p. 17), this species shows a decrease toward the mountains in the number of dorsal rays. The actual counts follow:

<i>Dorsal rays</i>	12	13	14	15	16	17
Specimens from about Puerto Barrios and Amates	—	4	22	25	11	2
Specimens from near Gualan	2	5	13	2	—	—

Genus 27. *Heterandria* Agassiz

There seems to be no reason now for referring any but the type species, *H. formosa*, to this genus. Regan in 1913 (*l.c.*, p. 995) retained only one additional species in the genus, namely *H. fasciata*. This is more probably a species of *Poeciliopsis*. Two other species, known from females only, still remain referred to *Heterandria*. These are *H. cubensis* from Cuba, which is more probably a species of *Toxus* (which see), and *H. hasemani* Henn,⁴⁰ from the Paraguay basin in Bolivia, possibly belonging to the genus *Pamphorichthys*, as the describer suggested.

62. *Heterandria formosa* Agassiz

Unrecorded material of this species has been examined from four localities in Florida: Lakeland, Fort Lauderdale, Sanford and Haines City.

Genus 28. *Priapella* Regan

Priapella Regan, Proc. Zool. Soc. London, 1913, p. 992.

63. *Priapella bonita* Meek

Gambusia bonita Meek, Publ. Field Mus., (Zool.) 5, 1904, p. 132, fig. 39; Regan, Biol. Centr.-Am., Pisces, 1907, p. 95.

Priapella bonita Regan, Proc. Zool. Soc. London, 1913, p. 993, fig. 170 e.

³⁹ Bull. Am. Mus. Nat. Hist., 23, 1907, p. 105.

⁴⁰ Ann. Carn. Mus., 10, 1916, p. 116, pl. 20, fig. 1.

The color markings of this Mexican species consist of dark margins about the scale pockets, of a narrow streak along the mid-dorsal line and on each edge of the caudal peduncle, and of a hair-like axial line.

Genus 29. *Allogambusia* Hubbs

Allogambusia Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 8.

This genus appears to be well distinguished from all allies of Heterandria by the peculiar structure of the intromittent organ. Meek and Hildebrand (1916, p. 321) give a good figure of the gonopodium, which errs, however, in a few minor details. Ray 3 is not branched, as shown, but the anterior edge bears a somewhat crenate keel. The elongated curved segment at the tip of the organ is composed solely of the anterior branch of ray 4. In this respect *Allogambusia* resembles *Pseudoxiphophorus* and *Heterandria*. In the development of the process of ray 3 it resembles the *Girardinini*, and in the thickening of ray 4, the *Gambusiini*. Which if any of these similarities are indicative of actual relationship I do not venture to guess.

64. *Allogambusia tridentiger* Garman

Gambusia tridentiger Garman, Mem. Mus.^e Comp. Zool., 19, 1895, p. 89, pl. 4, fig. 10; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 3, 1898, p. 2833; Regan, Biol. Centr.-Am., Pisces, 1907, p. 95.

Priapichthys tridentiger Regan, Proc. Zool. Soc. London, 1913, p. 992; Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1916, p. 320, fig. 6; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 181.

Allogambusia tridentiger Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 8.

The specimens of this species examined were collected by Meek and Hildebrand at Arrigan and in the Rio Chame at Chame, Panama.

65. *Allogambusia cana* Meek and Hildebrand

Gambusia cana Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1916, p. 321.

Priapichthys tridentiger cana Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1916, p. 321.

Priapichthys tridentiger canus Eigenmann, Mem. Carn. Mus., 9, 1922, p. 181.

Allogambusia cana Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 8, footnote (name only).

In some of the female types the dark bars are obscurely evident. It is not improbable that this species is identical with typical *tridentiger*.

Genus 30. *Alloheterandria* Hubbs66. *Alloheterandria nigroventralis* Eigenmann and Henn

Gambusia nigroventralis Eigenmann and Henn, Ind. Univ. Studies, No. 16, 1912, p. 26.

Priapichthys nigroventralis Regan, Proc. Zool. Soc. London, 1913, p. 992; Henn, Ann. Carn. Mus., 10, 1916, p. 115, fig. 3; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 180.

Alloheterandria nigroventralis Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 9.

Gambusia caudovittata Regan, Ann. Mag. Nat. Hist., (8) 12, 1913, p. 471; Proc. Zool. Soc. London, 1913, p. 986.

The paratypes of this species in the Indiana University collection have been examined, and I have confirmed the characters of the gonopodium as figured by Henn.

67. *Alloheterandria caliensis* Eigenmann and Henn

Gambusia caliensis Eigenmann and Henn, in Henn, Ann. Carn. Mus., 10, 1916, p. 113; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 180, pl. 27, fig. 5.

Being known only from females, the genetic identity of this species remains unknown. I think it extremely improbable that it will prove to be a *Gambusia*, and know no better place to leave it provisionally than in *Alloheterandria*.

Genus 31. *Neoheterandria* Henn

Neoheterandria Henn, Ann. Carn. Mus., 10, 1916, p. 118; Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 9.

68. *Neoheterandria elegans* Henn

Neoheterandria elegans Henn, *l.c.*, 1916, p. 118, fig. 5, and pl. 19, figs. 4, 5; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 184; Hubbs, *l.c.*, 1924, p. 9.

Genus 32. *Pseudopoecilia* Regan

Pseudopoecilia Regan, Proc. Zool. Soc. London, 1913, p. 995, fig. 170 F; Henn, *l.c.*, 1916, p. 118, fig. 6; Hubbs, *l.c.*, 1924, p. 9.

69. *Pseudopoecilia festae* Boulenger

Poecilia festae Boulenger, Boll. Mus. Zool. Torino, 13, 1898, p. 13.

Pseudopoecilia festae Regan, *l.c.*, 1913, p. 996, fig. 170 F; Henn, *l.c.*, 1916, p. 119; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 184.

70. *Pseudopoecilia fria* Eigenmann and Henn

Poecilia fria Eigenmann and Henn, Ind. Univ. Studies, No. 19, 1914, p. 13.

Pseudopoecilia fria Henn, Ann. Carn. Mus., 10, 1916, p. 119, fig. 6; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 184, pl. 27, figs. 6, 7.

I have examined the types of this species, and find the structure of the gonopodium to be as figured by Henn.

The teeth consist of an even outer row of fairly strong but narrow incisors, with more or less pointed and recurved tips, and an inner band of fine pointed teeth.

It is rather probable that this species will prove inseparable from *P. festae*. The differences in scale counts as given by the respective authors are probably due to differences in method of counting, and some variation in number of serrae on the gonopodium is to be expected.

Tribe 3. Girardinini Hubbs

This group, an offshoot from the Heterandriini, is confined to Cuba, so far as definitely known. It is true that Garman⁴¹ recorded a species of Glaridodon (= Glaridichthys) from Chihuahua, Mexico, and referred *Girardinus januarius* to the same genus. The first, *latidens*, is probably a species of Poeciliopsis, with erroneous locality; the second is the type of Phalloptychus.

Genus 33. *Toxus* Eigenmann

Toxus Eigenmann, Bull. U. S. Fish Comm., 1902 (1903), p. 226; Regan, Proc. Zool. Soc. London, 1913, p. 1002; Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 9.

71. *Toxus riddlei* Eigenmann

Toxus riddlei Eigenmann, l.c., 1903, p. 226, figs. 6, 7.

72. *Toxus cubensis* Eigenmann

Heterandria cubensis Eigenmann, l.c., 1903, p. 227, fig. 8.

Heterandria cubensis Eigenmann is almost certainly not referable to *Heterandria*, a genus which is not represented in the Antilles, nor closely related to any occurring there. I provisionally refer the species, no males having been collected, to the genus *Toxus*, as it agrees fairly well with *Toxus riddlei* in the structure of the jaws and in dentition, as well as in coloration. The small mouth of *cubensis* is broadly V-shaped when viewed from in front, as in *Glaridichthys* and *Toxus*, rather than almost strictly transverse, as in *Girardinus*. The lips are also much thinner than in the latter genus, and the jaws are more firmly united, though to be sure not so firmly as in *T. riddlei*.

Regan's reference (l. c., 1913, p. 1002) of *H. cubensis* to the synonymy of *Girardinus metallicus* was of course unjustified.

In addition to the type material two specimens of this species have been examined which were collected in western Cuba by T. L. Hankinson,

⁴¹ Mem. Mus. Comp. Zool., 19, 1895, p. 42.

one having come from Calabazar. In these the belly is less inflated than in the type (specimens less mature?) and the head is relatively longer, being contained about 4 times in the standard length; depth, 4.4; scales, 29; lengths, 21 and 24 mm. to caudal.

Genus 34. *Glaridichthys* Garman

Glaridodon Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 40 (not *Glaridodon* Seeley).

Glaridichthys Garman, Amer. Nat., 30, 1896, p. 232; Eigenmann, Bull. U. S. Fish Comm., 1902 (1903), p. 223; Regan, Proc. Zool. Soc. London, 1913, p. 1000; Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 9.

My disposition of the two non-Antillean species accredited by Garman to this genus is discussed above.

73. *Glaridichthys uninotatus* Poey

Girardinus uninotatus Poey, Memorias, 2, 1861, pp. 309, 383, etc.

Heterandria uninotata Jordan, Proc. U. S. Nat. Mus., 9, 1887, p. 563; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 687.

Glaridodon uninotatus Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 41, pl. 5, fig. 10; pl. 8, fig. 14.

Glaridichthys uninotatus Eigenmann, Bull. U. S. Fish Comm., 1902 (1903), p. 223; Regan, Proc. Zool. Soc. London, 1913, p. 1000 (synonymy in part excepted).

The teeth in this species consist of an even and slightly curved outer row and a wide inner band. The outer premaxillary teeth are erect and obtusely-pointed, with the broad bases contiguous. The outer mandibular teeth are quite different in structure, being broad and oblique, especially toward the symphysis, where the *inner* side of the teeth forms the cutting edge.

The essential color pattern of *Glaridichthys uninotatus* consists of transverse lateral bars, and of a small spot on each side near the origin of the anal fin. One of the lateral bars, above the origin of the anal fin, is usually intensely black, while the other bars are quite faint. In one of the specimens examined, however, the anal spot is enlarged to the size of the usual lateral spot (the intensified bar), which in this fish is not distinct on either side. In another aberrant specimen, the lateral spot of one side is formed from the bar next posterior to the one intensified on the opposite side.

74. *Glaridichthys torralbasi* Eigenmann

Glaridichthys torralbasi Eigenmann, Bull. U. S. Fish Comm., 1902 (1903), p. 225, fig. 4.

As described, the dentition of this species is quite different from that of *G. uninotatus*.

75. *Glaridichthys falcatus* Eigenmann

Glaridichthys falcatus Eigenmann, *l.c.*, 1903, p. 224, figs. 2, 3; Brown, in Nichols, Bull. Am. Mus. Nat. Hist., 31, 1912, p. 179.

A re-examination of the type material of this species fails to confirm Regan's view (*l. c.*, 1913, p. 1000) that it is synonymous with *G. unnotatus*. The correlated characters of the falcated fins and plain coloration seems to be especially significant, although Regan mentions that "the slight production of the vertical fins is found in some specimens with the typical coloration."

In addition to the characters mentioned, the material at hand indicates that *G. falcatus* has a more flattened dorsal contour, and a longer and decidedly more pointed head. In *falcatus* the length of the head is contained rather less than 4.0, instead of from 4.0 to 5.0 times in the standard length.

Genus 35. *Girardinus* Poey

Various species other than the type (*metallicus*), both from Cuba and from distant lands, have been erroneously referred to this genus. The non-Cuban species are distributed through the system. The Cuban species referred to this genus have been—

Girardinus metallicus Poey.

Girardinus unnotatus Poey, 1861, type of *Glaridichthys* Garman.

Girardinus denticulatus and *G. creolus* Garman, 1895,⁴² which together perhaps form a related but yet un-named genus.

Girardinus garmani Eigenmann, 1903, a synonym of *G. metallicus*.

The teeth (in *G. metallicus*) are uniserial or nearly so, the inner band being nearly or quite obsolete. The teeth are rather irregularly disposed along an arc on each side of each jaw, the rows being incurved to meet at an angle at the symphysis. The individual teeth are rather narrowly spatulate and fairly close-set.

76. *Girardinus metallicus* Poey

In the breeding males of this species, that is, those having the gonopodium completely developed, the body is crossed by dark bars, whereas in others of various size in the same lots, having the gonopodium imperfectly formed, the bars are not evident. *Girardinus garmani* Eigenmann⁴³ was based on such a non-breeding male. To be sure the describer of *garmani* pointed out one other supposed difference, namely the number of

⁴² Bull. Mus. Comp. Zool., 19, 1895, p. 47.

⁴³ Bull. U. S. Fish Comm., 1902 (1903), p. 226, fig. 5.

anal rays. But in males of both color types, including a paratype of *garmani*, we count 10 anal rays (the last divided to base).

The young females show a black spot on the anal corresponding to that on the dorsal, and perhaps to a similar spot in *Heterandria formosa*, but this spot disappears when the females have attained a length of 25 mm. (to caudal). Occasional specimens are irregularly and asymmetrically blotched with black.

In addition to Eigenmann's extensive material, sets taken by Hankinson in a muddy fresh-water lagoon at Santiago de las Vegas, and from a small ditch connected with the sea at Calabazar, both in Cuba, have been examined.

Tribe 4. Cnesterodontini Hubbs

This tribe⁴⁴ includes certain South American genera (*Darienichthys*, *Diphyacantha*, *Cnesterodon*, *Phalloceros* and the remarkable *Phallotorynus*), all of which have the terminal segment of ray 3 (first prolonged ray of gonopodium) produced as a simple to very elaborate process. Except to transfer the genus *Darienichthys* to this group, and to indicate its close relationship to *Diphyacantha*, I have nothing new to add to Henn's account⁴⁵ of these genera.

Genus 36. *Darienichthys* Hubbs

Darienichthys Hubbs, *l.c.*, 1924, p. 8.

Misinterpreting Meek and Hildebrand's figure of the gonopodium of their *Priapichthys dariensis*, the type and only known species of *Darienichthys*, I have located this genus among the *Heterandriini*. Having before me the type material of both *Priapichthys dariensis* and *Diphyacantha chochoensis*, I discover that they are closely related species. The genus *Darienichthys* may be retained, however, as a close ally of *Diphyacantha* among the *Cnesterodontini*. The two genera differ as indicated in the following analysis, which should take a place in my 1924 key under division W¹.

- a¹.—Gonopodium rather short, between two-fifths and one-third standard length of body; process at tip of ray 3 more or less retrorse to axis of gonopodium; serrae of posterior branch of ray 4 weak (but more numerous than shown in Meek and Hildebrand's figure)36. *Darienichthys*
 a².—Gonopodium elongate, nearly one-half the standard length; process at tip of ray 3 antorse to axis of gonopodium, projecting out beyond the tip of ray 4; serrae of posterior branch of ray 4 strong.....37. *Diphyacantha*

⁴⁴ See Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 9.

⁴⁵ Ann. Carn. Mus., 10, 1916, pp. 113-115, 123-131.

77. *Darienichthys darienensis* Meek and Hildebrand

Gambusia darienensis Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1913, p. 88.

Priapichthys dariensis Meek and Hildebrand, *ibidem*, 10, 1916, p. 321, fig. 7; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 181.

Darienichthys dariensis Hubbs, *l.c.*, 1924, p. 8.

This species is very similar to *Diphyacantha chocoensis* not only in the generic features, but also in general appearance and coloration. The dark bars on the male are more numerous and darker than in that species, however.

The types of *darienensis* came from the Pacific streams of Panama toward the Colombian border (the specimens at hand from the Rio Yape and Rio Cupe). The types of *chocoensis* were collected in the lower part of the San Juan basin, a stream somewhat farther to the south, in Colombia.

Genus 37. *Diphyacantha* Henn

Diphyacantha Henn, *l.c.*, 1916, p. 113, fig. 2; Hubbs, *l.c.*, 1924, p. 9.

78. *Diphyacantha chocoensis* Henn

Diphyacantha chocoensis Henn, *l.c.*, 1916, p. 114, fig. 2; pl. 19, figs. 1, 2; Eigenmann, *l.c.*, 1918, p. 184; Hubbs, *l.c.*, 1924, p. 9.

The relationships of this genus and species to *Darienichthys darienensis* are quite intimate, as indicated above.

Subfamily 2. POECILIOPSINAE Hubbs

Those poeciliid fishes in which the rays of the gonopodium are infolded to form a tube on the left⁴⁶ side of the fin comprise a natural group of genera which I have specified as the Poeciliopsinae.⁴⁷ This group is made up of elements formerly referred to the Gambusiinae and the Poeciliinae.

The genera of this group have not been satisfactorily separated. Having before me now nearly all of the known species, the following revised analysis of the group is offered. The chief alterations from my former key are due to the discovery that *Leptorhaphis* can not be separated by any known character from *Poeciliopsis*, which in turn is a complex of three distinct groups, *Poeciliopsis*, *Poecilistes* and *Aulophallus*.

⁴⁶ The tube was inadvertently stated to be on the right side of the fin in my former paper, the figure of the gonopodium illustrating the group being shown as a mirror-image of the real fin.

⁴⁷ Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, pp. 9-10.

Key to the Genera of Poeciliopsinae

- a¹.—Rays of the elongate gonopodium folded together to form an imperfectly closed tube on left side of fin.⁴⁸—Mouth with lateral cleft more or less reduced, the dentary bones more or less weakened; the teeth implanted in the flesh only; intestine more or less elongated (*Poeciliopsinae*).
- b¹.—Gonopodium without horn-like appendages; ray 4 not forming a hook at its tip; ray 5 not extending to extreme tip of organ.
- c¹.—Antorse distal serrae of posterior branch of ray 4 rudimentary. Inner band of teeth reduced in width (*Phallichthys* excepted) or obsolete.
- d¹.—Body rather slender, more or less distorted in form (the axis angulated). Dorsal fin inserted behind origin of anal. Teeth of main row usually little compressed, the inner distal angles of the mandibular teeth not definitely rounded off nor approximated and aligned to form a common cutting edge. Gonopodium with a more or less modified membranous tip.
- e¹.—Mouth narrow, with a moderately developed lateral gape, broadly A-shaped when viewed from in front. Dentary bones rather broad and solid, connected rather firmly. Teeth of main row somewhat compressed, rather firmly implanted in skin of lips; inner band of teeth more or less narrow, but always developed in both jaws. Intestine not very extensively convoluted. Crescentic horn in membranous tip of gonopodium not developed; spines of posterior branch of ray 4 not bilaterally asymmetrical; no segments coalesced. *Pacific Coast streams from Arizona to Colombia* 38. *Poeciliopsis*
- e².—Mouth rather wide, with lateral cleft scarcely developed, so that the gape is almost strictly transverse when viewed from either above or before. Dentary bones narrow and delicate, weakly conjoined. Teeth of main row more slender, curved, loosely implanted in lips; teeth of inner band obsolete. Intestine more extensively convoluted.
- f¹.—Modification of mouth and dentition less extreme: mouth moderately wide, with very slight lateral cleft; teeth only moderately incurved, not describable as hair-like. Gonopodium with a "crescentic horn" in the membranous tip; segments of ray 3 and also anterior branch of 4 consolidated opposite developed distal serrae; two halves of posterior branch of ray 4 separated, most of the segments of the right side flattened, and their thorn-like serrae modified into flat two-horned processes; segments of anterior branch of ray 5 squarish, or longer than broad. *Both slopes of southern Mexico and Guatemala* 39. *Poecilistes*
- f².—Modification of mouth and dentition more extreme: mouth wide, without lateral cleft; teeth hooked inward, very long and hair-like, and very loose. Gonopodium without the "crescentic horn" in membranous tip; none of the segments consolidated; two halves of posterior branch of ray 4 closely united, bearing an apparently single series of thorn-shaped serrae; segments of anterior branch of ray 5 more oblique, and greatly widened, as though in compensation for lack of

⁴⁸ Out of four males of *Xenophallus*, however, the tube is on the left side in two, and on the right side in two.

- specialization of ray 4. *Pacific slope of Costa Rica and western Panama*40. *Aulophallus*
- d².—Body deep, with the axis scarcely angulated (somewhat bent in large females). Dorsal fin inserted in advance of origin of anal. Teeth of main row incisor-like, more or less oblique, and with the inner distal angles of the teeth, especially on the mandible, rounded off and approximated and aligned to form a common cutting edge; inner band of teeth rather broad. Gonopodium without a modified membranous tip, without a crescentic horn in terminal membrane, without coalesced segments, and without bilaterally asymmetric serrae; segments of ray 5 not greatly widened. *Atlantic streams from Guatemala to Panama*41. *Phallichthys*
- c².—Antorse distal serrae of posterior branch of ray 4 well developed. Inner band of teeth broad. Body moderately robust, not much distorted in form. Dorsal fin originating not far behind anal insertion. *Eastern South America*.....42. *Phalloptychus*
- b².—Gonopodium with two prominent horn-like appendages, one, like the excrescence on a pelican's bill, on the front edge of ray 3, the other, a long curved horn attached at base to posterior edge of ray 4; all three rays extending to extreme tip of organ. Form of mouth and dentition as in *Poeciliopsis*. Form of body little distorted. Dorsal fin originating slightly in advance of anal. *Atlantic streams of Costa Rica*43. *Xenophallus*

Genus 38. *Poeciliopsis* Regan

Poeciliopsis Regan, Proc. Zool. Soc. London, 1913, p. 996 (in part; original description; no type species indicated); Henn, Ann. Carn. Mus., 10, 1916, p. 119 (type fixed as *Poecilia presidionis* Jordan and Culver; this action invalidating Jordan's later designation of *P. isthmensis* as type); Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1916, p. 324 (in part); Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 10 (in part).

Leptorhaphis Regan, l.c., 1913, p. 998; Hubbs, l.c., 1924, p. 10.

79. *Poeciliopsis occidentalis* Baird and Girard

Heterandria occidentalis Baird and Girard, Proc. Acad. Nat. Sci. Phila., 1853, p. 390; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 689.

Girardinus occidentalis Girard, U. S. Mex. Bound. Surv., 1858, p. 73, pl. 39, figs. 16-19; Proc. Acad. Nat. Sci. Phila., 1859, p. 119; Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 354; Jordan and Gilbert, Bull. U. S. Nat. Mus., 16, 1883, p. 349; Eigenmann, Proc. U. S. Nat. Mus., 16, 1893, p. 58.

Poecilia occidentalis Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 71; Rutter, Proc. Calif. Acad. Sci., (2) 6, 1896, pp. 261 and 267; Gilbert and Scofield, Proc. U. S. Nat. Mus., 20, 1898, p. 498; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 3, 1898, p. 2833; Meek, Publ. Field Mus., (Zool.) 3, 1902, p. 122; 5, 1904, p. 150; Regan, Biol. Centr.-Am., Pisces, 1907, p. 101; Ann. Mag. Nat. Hist., (8) 2, 1908, p. 459; Snyder, Proc. U. S. Nat. Mus., 49, 1915, p. 585.

Mollienisia occidentalis Regan, Proc. Zool. Soc. London, 1913, p. 1013; Fowler, Proc. Acad. Nat. Sci. Phila., 72, 1920 (1921), p. 399.

Girardinus sonoriensis Girard, Proc. Acad. Nat. Sci. Phila., 1858, p. 101; Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 355.

The successive reference of this species to *Heterandria*, *Girardinus*, *Poecilia* and *Mollienisia* is an expression of the doubts involved in classifying the species of poeciliids in the absence of male. Having specimens of that sex, it turns out that *occidentalis* has been classified as erroneously as variably. It is a species of *Poeciliopsis*, separable only on careful study from *P. infans* of the Lerma basin and *P. balsas* of the Balsas basin. It is the northernmost species of the subfamily.

I have examined series of this species from Huachuca Mountains, Tempe, Sabino Canyon in Santa Catalina Mountains, and Rio Santa Cruz at Tucson, all in Arizona, and from the Yaqui River and from Hermosillo, in Sonora, Mexico.

P. occidentalis is extremely similar to *P. infans*, resembling that species exactly in all those respects in which *P. balsas* differs, except that the head is less sharply pointed, and that the whole build appears heavier-set. This difference shows up in the measurement of the interorbital, the bony width of which in *occidentalis* is equal to the distance from tip of snout to or almost to the hind border of orbit, in *infans* equal to the distance from tip of snout to some point in the posterior two-thirds of the length of the pupil. The black peritroct blotch is smaller than in *infans*, but otherwise the coloration is similar.

80. *Poeciliopsis infans* Woolman

Gambusia infans Woolman, Bull. U. S. Fish Comm., 14, 1894, p. 62, pl. 2; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 680; pt. 3, 1898, p. 2832; Dugès, Men. Soc. Ant. Alzate, 17, 1902, p. 121; Meek, Publ. Field Mus., (Zool.) 3, 1902, p. 99; 5, 1904, p. 131, fig. 38; Regan, Biol. Centr.-Am., Pisces, 1907, p. 96 (in part).

Leptorhaphis infans Regan, Proc. Zool. Soc. London, 1913, p. 998 (in part).

Gambusia affinis Pellegrin, Bull. Mus. Hist. Nat. Paris, 7, 1901, p. 205; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 4, 1900, p. 3257, pl. 113, fig. 299 (but not fig. 299a); Meek, Publ. Field Mus., (Zool.) 7, 1907, p. 155 (material re-examined). (Not *Heterandria affinis* Baird and Girard.)

This species alone represents the genus—in fact the entire family—in the highly distinctive Lerma fauna of Mexico.

Among the types of the species,⁴⁹ as well as in other lots, there are several males, showing the characteristic gonopodial features of the genus.

The color varies greatly in intensity even in fishes from the same locality. Some, like the types, are very pale, the dark scale margins being fairly indistinct, while others are dark, with the scale pockets broadly margined with black. Some specimens indeed, of both sexes, appear melanistic, and some males from Huingo are almost entirely black. In contrast with this variation in color intensity, certain features of the color pattern are con-

⁴⁹ Jordan and Evermann erroneously state that the types include only males. The specimen figured by Woolman, among others, is a female.

stant. The scale pockets are margined with darker, except on the belly, the width of the margin decreasing downward; the margins along the axial series of scales are more or less intensified. The fine axial streak, from which dark pigment often diffuses outward, is intensely black posteriorly, but fades out near the head; the lower edge of the caudal peduncle is marked by a broader blackish streak; the mid-dorsal line, by a streak which is much fainter, especially before the dorsal fin.

Among several other series examined is one from a very hot spring at Ixtlán, Michoacan, Mexico, collected by Dr. A. Dugès.

81. *Poeciliopsis balsas*, new species

Gambusia gracilis Meek, Publ. Field Mus., (Zool.) 3, 1902, p. 99; 5, 1904, p. 130 (not *Xiphophorus gracilis* Heckel).

Gambusia infans Regan, Biol. Centr.-Am., Pisces, 1907, p. 96 (in part).

Leptorhaphis infans Regan, Proc. Zool. Soc. London, 1913, p. 998 (in part).

The attempts to identify the *Poeciliopsis* of the Balsas basin with either *Hemixiphophorus gracilis* Heckel or with *Poeciliopsis infans* have not been successful. It is probably not even closely related to *H. gracilis*, but is very similar to *P. infans* of the adjacent, though faunally distinct, Lerma basin.

Poeciliopsis balsas differs from *P. infans* in the following particulars. The head is less sharply pointed, and the lower jaw less obviously projects. The dorsal fin is usually inserted more posteriorly, the distance from its origin to the caudal base being contained 1.8 to 2.1, rather than from 1.6 to 1.8 times, in the distance between the fin and tip of snout. The mid-dorsal streak is more prominent than the one on the lower edge of the caudal peduncle, rather than the reverse. The scale margins along the series following the axial streak are darkened, and vertical bars are faintly apparent; neither of these features are evident in *infans*.

The species is based on the material collected and described by Meek. A specimen from Balsas, on the Rio Balsas, Guerrero, Mexico, an adult female 33 mm. long to caudal fin, will serve as the type. Paratypes are from Balsas, Chietla, Puente de Ixtla, Cuautla, Yautepec and Jojutla, all in the Rio Balsas basin of Mexico. The types are deposited in the Field Museum of Natural History.

(*Balsas*: named for the Rio Balsas, to the system of which this species appears to be confined.)

82. *Poeciliopsis latidens* Garman

Glaridodon latidens Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 42, pl. 5, fig. 2.

Glaridichthys latidens Meek, Publ. Field Mus., (Zool.) 5, 1904, p. 134.

Garman described this species as from Chihuahua, Mexico, but no subsequent author has found a fish of this type in northeastern Mexico. From

the description the species appears to be referable to *Poeciliopsis*, but whether it is identical with any of the barred species listed below can not be stated at present.

83. *Poeciliopsis presidionis* Jordan and Culver

Poecilia presidionis Jordan and Culver, Proc. Calif. Acad. Sci., (2) 5, 1895, p. 413, pl. 39; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 697; pt. 4, 1900, pl. 114, fig. 303; Meek, Publ. Field Mus., (Zool.) 5, 1904, p. 152.

Girardinus presidionis Regan, Biol. Centr.-Am., Pisces, 1907, p. 99.

Poeciliopsis presidionis Regan, Proc. Zool. Soc. London, 1913, p. 996, fig. 170 D.

The teeth of the inner band are well developed in this species, contrary to Regan's statement of 1907.

84. *Poeciliopsis fasciata* Meek

Gambusia fasciata Meek, Publ. Field Mus., (Zool.) 5, 1904, p. 129, fig. 37; Regan, Biol. Centr.-Am., Pisces, 1907, p. 95; 1908, p. 190.

Heterandria fasciata Regan, Proc. Zool. Soc. London, 1913, p. 995.

The type material of this Mexican species, as well as the specimens studied by Regan, contained no males. Therefore the generic status of the species can not be regarded as definitely understood. In general appearance, especially in coloration, it most resembles the species of *Poeciliopsis*.

85. *Poeciliopsis turrubarensis* Meek

Gambusia fasciata Meek, Publ. Field Mus., (Zool.) 7, 1907, p. 137 (material from Guatemala, misidentified).

Gambusia turrubarensis Meek, Publ. Field Mus., (Zool.) 10, "Sept. 1912," p. 71 (published September 18, 1912).

Priapichthys turrubarensis Regan, Proc. Zool. Soc. London, 1913, p. 992; Meek, Publ. Field Mus., (Zool.) 10, 1914, p. 113.

Heterandria colombianus Eigenmann and Henn, Ind. Univ. Studies, No. 16, "Sept. 1912," p. 27 (issued December 23, 1912); Regan, Proc. Zool. Soc. London, 1913, p. 996.

Poeciliopsis colombiana Henn, Ann. Carn. Mus., 10, 1916, p. 120; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 182, pl. 27, figs. 8, 9.

Poeciliopsis colombianus Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1916, p. 325.

Priapichthys fosteri Hildebrand, Bull. U. S. Bur. Fish., 41, 1925, p. 260, figs. 14, 15.

Of this species I have examined a considerable series of specimens, as follows.

1. The set from Caballo Blanco, Guatemala, recorded erroneously by Meek as *Gambusia fasciata*. In this lot is a small male which shows the generic characters of the gonopodium.

2. Large series from Costa Rica, including the types of *turrubarensis* from Turrubales, some of which are males, and other sets from Rio Grande de Orotina; Rio Cañas, Taboga; Jesus María; Rio Higuerón.

3. Four young specimens from the Rio San Bartola near mouth in Bahía de Dulce, at Robo de Puero, on the Pacific side of western Panama.

4. Two female paratypes of *H. colombianus*.

On the comparison of paratypes of both nominal species, I was unable to find any means of distinguishing *colombiana* from *turubarensis*. *Priapichthys fosteri*, recently described from El Salvador, is apparently the same.

Genus 39. *Poecilistes*, new genus

Poecilopsis Hubbs, Misc. Publ. Zool., Univ. Mich., No. 13, 1924, p. 10 (footnote excepted).

Type, *Heterandria lutzi* Meek.

This genus differs sharply from *Poecilopsis* in dentition, structure of mouth and the detailed architecture of the gonopodium. Its characters are given in the preceding key of the genera of the subfamily *Poecilopsinae*.

(*Poecilistes*: an unused modification of the name *Poecilia*.)

86. *Poecilistes pleurospilus* Günther

Girardinus pleurospilus Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 355; Trans. Zool. Soc. London, 6, 1868, p. 486, pl. 87, fig. 1; Regan, Biol. Centr.-Am., Pisces, 1907, p. 100.

Heterandria pleurospilus Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 148; Meek, Publ. Field Mus., (Zool.) 5, 1904, p. 148; Miller, Bull. Am. Mus. Nat. Hist., 23, 1907, p. 106.

Poecilopsis pleurospilus Regan, Proc. Zool. Soc. London, 1913, p. 997.

Heterandria lutzi Meek, Publ. Field Mus., (Zool.) 5, 1904, p. 148, fig. 47; Miller, Bull. Am. Mus. Nat. Hist., 23, 1907, p. 107.

Girardinus lutzi Regan, Biol. Centr.-Am., Pisces, 1907, p. 99.

Poecilopsis lutzi Regan, Proc. Zool. Soc. London, 1913, p. 996; Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 26, pl. 2.

Priapichthys letonai Hildebrand, Bull. U. S. Bur. Fish., 41, 1925, p. 258, figs. 12, 13.

Specimens of *Poecilistes* from various localities show much variation in the number and size of the lateral spots but I am not now able on this (or any other) basis to distinguish *lutzi* and *letonai* as species distinct from *pleurospilus*.

My figure of the gonopodium of this species is inaccurate in a number of ways. In the first place I inadvertently showed the mirror image of the fin, and thus stated that the tube is on the right side of the fin, whereas in reality it is on the left side, as usually stated. The fifth ray was erroneously labelled; the anterior branch was indicated as 5m, the posterior branch as 5a; no median branch exists. The anterior branch of ray 4 has the two sides joined edge to edge, not side to side as shown.

Genus 40. *Aulophallus*, new genus

Type, *Poecilia elongata* Günther.

In the structure of the mouth and teeth this species resembles *Poecilistes*, being in fact even more extreme in these respects. In the detailed form of the segments of the gonopodium it shows, however, none of the striking modifications characteristic of that genus, a fact suggesting the independent origin of both groups from *Poeciliopsis*.

The characters of *Aulophallus* are given in the preceding key to the genera of the subfamily.

(*Aulophallus* = tube penis, or folded intromittent organ.)

87. *Aulophallus elongatus* Günther

Poecilia elongata Günther, Cat. Fishes Brit. Mus., 6, 1866, p. 342; Trans. Zool. Soc. London, 6, 1869, p. 484, pl. 85, fig. 2; Steindachner, Sitz. Akad. Wiss. Wien, 74, 1876, p. 67; Jordan and Gilbert, Proc. U. S. Nat. Mus., 5, 1882 (1883), p. 623; Jordan, *ibidem*, 8, 1885, p. 368; Jordan and Bollman, *ibidem*, 12, 1889, p. 180; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 697; pt. 3, 1898, p. 2834; Gilbert and Starks, Mem. Calif. Acad. Sci., 4, 1904, p. 50; Regan, Biol. Centr.-Am., Pisces, 1907, p. 102; Ann. Mag. Nat. Hist., (8) 2, 1908, p. 459.

Mollienisia elongata Regan, Proc. Zool. Soc. London, 1913, p. 1013.

Poeciliopsis elongatus Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1916, p. 324, fig. 9.

Poeciliopsis elongata Eigenmann, Carn. Mus., 9, 1922, p. 181.

Meek and Hildebrand's material of this Panama species, which obviously represents a new genus, has been examined. In agreement with Günther, and in disagreement with Steindachner and Meek and Hildebrand, I find but one row of teeth in *elongatus*; the latter authors have seemingly mistaken some of the fine buccal papillae for teeth.

Aulophallus elongatus is not, as Meek and Hildebrand suggested, identical with *Poeciliopsis colombiana* (= *turrubarensis*). It differs from that species not only in the generic features, but also in coloration, the vertical bars being wider and more diffuse, and well developed toward the caudal base, there being no unmarked interval in advance of the caudal fin as in that species.

88. *Aulophallus retropinna* Regan

Poecilia retropinna Regan, Ann. Mag. Nat. Hist., (8) 2, 1908, p. 458.

Poeciliopsis retropinna Regan, Proc. Zool. Soc. London, 1913, p. 997.

This species has hitherto been known from but a single specimen, the adult female from Costa Rica described by Regan in 1908. There is at hand one male showing the features of the gonopodium listed in the key, and several females. These were collected by Dr. Behre in streams on the Pacific side of western Panama: in Quebradas Sombrero, Salao, Copera and

Iletra below Copera, all in streams tributary to the Rio Chiriqui del Tire, taken on March 6 to 12, 1923.

The origin of the dorsal is located little behind that of the anal, about midway between tip of snout and end of caudal fin, or somewhat farther forward or backward.

This species is the most plainly colored of any in the subfamily. Even the half-grown show no trace of vertical bars or even of lateral spots.

Regan has indicated the characters by which this species may be distinguished from *A. elongatus*.

Genus 41. *Phallichthys* Hubbs

Poecilia and *Poeciliopsis* of authors (in part).

Phallichthys Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 10.

This genus is closely related to *Poeciliopsis*, differing as indicated in the key to the genera of the *Poeciliopsinae*. It is confined to Atlantic streams from Guatemala to Panama.

89. *Phallichthys amates* Miller

Poecilia amates Miller, Bull. Am. Mus. Nat. Hist., 23, 1907, p. 108, fig. 1.

Poeciliopsis amates Henn, Ann. Carn. Mus., 10, 1916, p. 120, fig. 7; Hubbs, *l.c.*, 1924, p. 10.

Phallichthys amates Myers, The Fish Culturist, 4, 1925, p. 370.

Numerous paratypes of this species from Guatemala, as well as a specimen from Tela, Honduras, have been examined.

90. *Phallichthys pittieri* Meek

Poecilia pittieri Meek, Publ. Field Mus., (Zool.) 10, 1912, p. 71.

Poeciliopsis pittieri Regan, Proc. Zool. Soc. London, 1913, p. 997; Meek, Publ. Field Mus., (Zool.) 10, 1914, p. 115.

Phallichthys pittieri Myers, The Fish Culturist, 4, 1925, p. 370.

Poeciliopsis isthmensis Regan, *l.c.*, 1913, p. 997, pl. 100, figs. 3 and 4, text fig. 161B; Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1916, p. 325.

Phallichthys isthmensis Myers, The Fish Culturist, 4, 1925, p. 371.

This species is very close to *P. amates*, and perhaps will eventually be found not specifically separable. The coloration is more diffuse, the dark bars in the male being scarcely better developed than in the female of *amates*, those in the female obsolete; the black margin of the dorsal is less abrupt, not contrasting so sharply with the ground color of the fin. The size attained is larger.

In addition to the specimens recorded by Meek from Costa Rica, series collected by Dr. Behre at several points connecting the ranges of the two

nominal species *pittieri* and *isthmensis* have been examined. These were taken in Skoon Creek, a tributary of the Rio Tilire, at Talamanca, Costa Rica, and in the following streams in western Panama: San San Creek, tributary to San San River, at the old farm of the same name; Fruitdale Creek, along railway spur behind Almirante; Quebrada Nigra, flowing into Almirante Bay; in Nomonuen Creek above Conquantu, Guibari Creek below Conquantu, and another creek below Conquantu, on right bank of the river, all three tributary to the Rio Cricamola.

I find no basis for the separation of *isthmensis* from *pittieri*.

Genus 42. *Phalloptychus* Eigenmann

Phalloptychus Eigenmann, Proc. U. S. Nat. Mus., 32, 1907, p. 430, fig. 6; Regan, *l. c.*, 1913, p. 999; Henn, *l. c.*, 1916, p. 120; Hubbs, *l. c.*, 1924, p. 10.

91. *Phalloptychus eigenmanni* Henn

Phalloptychus eigenmanni Henn, Ann. Carn. Mus., 10, 1916, p. 121, pl. 20, figs. 2, 3.

92. *Phalloptychus januarius* Hensel

Henn (*l. c.*, 1916, p. 122) has given a critical discussion of the synonymy of this species, to which reference should be made.

Genus 43. *Xenophallus* Hubbs

Xenophallus Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 10.

This genus is sharply differentiated from other poeciliopsines by the elaborate modification of the folded gonopodium.

Only the one species, from the Atlantic drainage of Costa Rica, is known.

93. *Xenophallus umbratilis* Meek

Gambusia umbratilis Meek, Publ. Field Mus., (Zool.) 10, 1912, p. 70; Regan, *l. c.*, 1913, p. 998.

Brachyrhaphis umbratilis Meek, Publ. Field Mus., (Zool.) 10, 1914, p. 115.

In the females of this species the scale pockets are bordered with brown on the upper surfaces and the upper and middle sides. The lower sides are paler, except for a blackish area between anal and pelvic fins, and blackish scale borders in a row just above. Axial streak faint, but evident except toward head; lower but not upper edge of caudal peduncle with a fine black streak.

Subfamily 3. POECILIINAE

The four genera comprising the tribes Pamphoriini and Xiphophorini (Hubbs, *l. c.*, 1924, p. 10) are not discussed in this paper.

Tribe 1. Poeciliini

Some modifications in the classification of the genera allied to *Poecilia*, which we adopted in 1924, must now be made. Therefore a revision of that section (d²) of my former key which applied to these genera is inserted here.

Key to the Genera of the Poeciliini

- a¹.—Membranous swelling along anterior margin of gonopodium modified into a prepuce-like hood; ray 3 with at most a very small hook; ray 4 straight or nearly so, with serrae only proximal to end of ray 5; ray 5 not arched backward. Inner pelvic rays abruptly shorter than the second ray. (Tribe Poeciliini)
- b¹.—Ray 5 with the last segment of the posterior branch not elongate, nor sharply retrorse. Ray 3 without a terminal hook (except in *Limia*).
- c¹.—Tips of all rays slender; ray 3 with either spines or a terminal hook.
- d¹.—Ray 3 with retrorse spines along anterior margin, not abruptly nor extensively slender at tip, and without a trace of a terminal hook.
- e¹.—Origin of dorsal fin of female scarcely behind that of anal. Proximal spine-bearing segments of ray 3 of gonopodium subspinous on posterior margin; subdistal segments of anterior branch of ray 4 short and spiniferous; processes of ray 5 distinctly spinous. Size of fish moderate.....44. *Poecilia*
- e².—Origin of dorsal fin of female above middle to end of anal base. Proximal spine-bearing segments of ray 3 of gonopodium strictly entire on posterior margin; segments of anterior branch of ray 4 greatly elongated and without trace of spines; processes of ray 5 hardly spinous. Size of fish minute45. *Micropoecilia*
- d².—Ray 3 without developed spines, and abruptly narrowed distally to form a long slender tip, which bears a strong terminal hook.....46. *Limia*
- c².—Tip of ray 3 and of posterior branch of ray 4 markedly clavate; ray 3 lacking both serrae and terminal hook47. *Parapoecilia*
- b².—Ray 5 with the last segment of the posterior branch elongate and abruptly retrorse (absent in *Mollienisia sphenops cuneata* and *M. s. vandepolli*), entering the posterior profile of the gonopodium.
- f¹.—Ray 3 without processes on posterior margin; terminal hook of same ray weakly or not at all developed. Fishes of minute size.
- g¹.—Tips of all the rays of the gonopodium slender; anterior branch of ray 4 often with weak serrae on posterior margin; spines of ray 3 strong; terminal hook of ray 3 wholly undeveloped. Sexual dimorphism in color and size strongly marked48. *Lebistes*
- g².—Tips of ray 3 and of posterior branch of ray 4 swollen (but less so than in *Parapoecilia*); posterior branch only of ray 4 serrate; spines of ray 3 weak; terminal hook of ray 3 often weakly developed. Sexual dimorphism slight49. *Allopoecilia*
- f².—Ray 3 with long more or less spinous processes on posterior margin; terminal hook of same ray well developed (sometimes weak in *Mollienisia sphenops cuneata* and *M. s. vandepolli*). Fishes of moderate size. Tips of all the gonopodial rays slender; segments of anterior branch of ray 4 without trace of serrae, and not markedly elongated; spines of ray 3 strong. Origin of

dorsal approximately over that of anal (in female). Sexual dimorphism rather slight (except in development of dorsal fin).....50. *Mollienisia*

Genus 44. *Poecilia* Bloch and Schneider

Neopoecilia Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., No. 13, 1924, p. 11.

On comparing the gonopodium of specimens of *Poecilia* from Porto Rico with Regan's figure (*l. c.*, 1913, fig. 173 C) of this organ for *Poecilia vivipara*, it appeared that the former differed in several trenchant details. They were then referred to a new genus and species, *Neopoecilia holacanthus*. But I have since determined that specimens from British Guiana show the same peculiarities, certain important details not having been illustrated by Regan. It therefore becomes apparent that *Neopoecilia* is a synonym of *Poecilia*. The gonopodial features as given by me for that nominal genus (*l. c.*, 1924, p. 11, fig. 5) will characterize *Poecilia*, as here restricted.

Species of diverse relationships have been described as new under the genus *Poecilia*, including some now referred to *Fundulus*, and to some related Old World genera, of the Cyprinodontidae; *Gambusia*, *Pseudopoecilia* and *Cnesterodon*, representing three tribes of the Gambusiinae; *Poeciliopsis*, *Aulophallus* and *Phallichthys* of the *Poeciliopsinae*; *Jenynsia*, of the *Anablepsidae*, as well as to the related genera *Limia*, *Lebistes* and *Mollienisia* of the *Poeciliini*.

94. *Poecilia vivipara* Bloch and Schneider

Neopoecilia holacanthus Hubbs, *l. c.*, 1924, p. 11, fig. 5.

Material of this species from Brazil, British Guiana and Porto Rico, recorded respectively by Starks, Eigenmann, and Evermann and Marsh, has been examined.

The two South American subspecies of *Mollienisia sphenops* (*M. s. cuneata* and *M. s. vandepolli*) closely approach *Poecilia vivipara* in gonopodial structure, as well as in general appearance, and in distribution. It is possible that the genera *Mollienisia* and *Poecilia* will eventually be shown to be connected by a chain of intermediate races. For the present, however, it seems best to retain them as distinct.

Genus 45. *Micropoecilia*, new genus

Type, *Poecilia vivipara parae* Eigenmann.

The group of species representing this genus differs from both *Poecilia* and *Mollienisia*, as here restricted, in the more posterior location of the dorsal fin; in the smooth posterior edge of ray 3 of the gonopodium, in the elongation of the segments of the anterior branch of ray 4 and in the

hardly spinous edge of ray 5; also in the smaller size attained. It differs further from *Poecilia* proper in the absence of spines on the anterior branch of ray 4, and from *Mollienisia* in the lack of the membranous hook at the tip of ray 3, and from most of the forms of *Mollienisia*, as well as from *Lebistes*, in the absence of a retrorse segment at the tip of the posterior branch of ray 5.

(*Micropoecilia*: signifying *Poecilia*-like fishes of reduced size.)

95. *Micropoecilia bifurca* Eigenmann

Acanthophaecelus bifurcus Eigenmann, Mem. Carn. Mus., 5, 1912, p. 459, pl. 65, figs. 4-6.

Poecilia parae Regan, l.c., 1913, p. 1006; Henn, l.c., 1916, p. 132. (In part.)

Micropoecilia bifurca of British Guiana is a doubtful species, possibly differing from typical *M. parae* in the form and structure of the gonopodium. In the specimens at hand, the outline of the organ resembles that of *Poecilia vivipara*, the last ray not being strongly curved distally as in typical *parae*; furthermore, the segments of the anterior branch of ray 4 seem less elongate.

96. *Micropoecilia parae* Eigenmann

Poecilia vivipera parae Eigenmann, Ann. N. Y. Acad. Sci., 7, 1894, p. 629.

Poecilia parae Regan, l.c., 1913, p. 1006, fig. 173B; Henn, l.c., 1916, p. 132 (in part).

The types have been re-examined.

97. *Micropoecilia picta* Regan

Acanthophaecelus melanzonus Eigenmann, Ann. Carn. Mus., 6, 1909, p. 51; Mem. Carn. Mus., 5, 1912, p. 457, pl. 64, fig. 6. (Females only.)

Poecilia picta Regan, l.c., 1913, p. 1007, pl. 100, figs. 1, 2, text fig. 173A; Henn, l.c., 1916, p. 133.

In this species the dorsal averages somewhat more posterior in position than in the two preceding, being 1.9 to 2.1 instead of 1.6 to 1.9 times as distant from tip of snout as from base of caudal (in females).

98. *Micropoecilia melanzona* Eigenmann

Acanthophaecelus melanzonus Eigenmann, Ann. Carn. Mus., 6, 1909, p. 51; Mem. Carn. Mus., 5, 1912, p. 457, pl. 64, fig. 5. (Type male only.)

Lebistes reticulatus Regan, l.c., 1913, p. 1007, 1008. (Reference to type of *melanzona* only.)

Poecilia melanzona Henn, l.c., 1916, p. 132, fig. 14.

I follow Henn in interpreting *melanzona* as a distinct species, known only from the type male.

99. *Micropoecilia branneri* Eigenmann

The synonymy of this species is given and its characters discussed by Regan (*l. c.*, 1913, p. 1007) and by Henn (*l. c.*, 1916, p. 134).

I do not feel convinced of the distinctness of any of these nominal species: *bifurca*, *parae*, *picta*, *melanzona* and *branneri* may all eventually be united with *parae*. The characters supposed to distinguish these species are all closely paralleled by differences within the species *Mollienisia sphenops*, as currently constituted. The types of these nominal species have been examined, but the material is quite insufficient for the final solution of the problem.

Genus 46. *Limia* Poey

We have notes on only one species of this genus.

100. *Limia vittata* Guichenot

We have specimens of *Limia vittata* taken by T. L. Hankinson at the following localities in Cuba: ditch connected with a bay, at Batabano; clear stream at Calabazar; muddy fresh-water of small lagoon at Santiago de las Vegas.

In either sex the body may be marked with large black blotches irregularly disposed.

Genus 47. *Parapoecilia* Hubbs

Parapoecilia Hubbs, *l. c.*, 1924, p. 11.

Only one species of this genus is now known.

101. *Parapoecilia hollandi* Henn

Limia hollandi Henn, Ann. Carn. Mus., 10, 1916, p. 138, fig. 17.

Genus 48. *Lebistes* Filippi

The serrae of the anterior branch of ray 4 are weak, often scarcely evident.

102. *Lebistes reticulatus* Peters

The synonymy of this species as given by Regan (*l. c.*, 1913, p. 1008) appears to be correct, except for the inclusion of *Acanthophaelus melanzonus*. That form, as Henn has shown (*l. c.*, 1916, p. 132, fig. 14), should stand as a species of *Poecilia* (or rather *Micropoecilia*).

Garman and Henn have both confused *Mollienisia sphenops vandepolli* (which see) with this species.

Genus 49. *Allopoecilia* Hubbs

Allopoecilia Hubbs, *l.c.*, 1924, p. 11.

Only the one species of this genus has been described.

103. *Allopoecilia caucana* Steindachner

Of this species we have a large series collected in pools in the stream-bed of Rio Camarones, at Arroyo de Arenas, Colombia.

Genus 50. *Mollienisia* Le Sueur

The species of *Mollienisia* have long been a puzzle to ichthyologists, and still remain so. Two main types of the genus may be distinguished, on the basis of the length of the dorsal fin. In the one group, consisting of *M. latipinna* Le Sueur and two closely allied forms from Middle America (*M. velifera* Regan and *M. petenensis* Günther), the dorsal rays, counting the last as branched, are 13 or more in number (very rarely 12); the origin of the fin as near, and usually much nearer tip of snout than base of caudal; the base of the dorsal is at least as long as its distance from the caudal base. In the other group, comprising the multitude of races allied to, or inseparable from *M. sphenops*, the dorsal rays are 7 to 11 (very rarely 12); the origin of the fin at most as near tip of snout as base of caudal, usually decidedly nearer the latter; the base of the dorsal not longer, usually shorter, than its distance from the caudal base.

Regan (1913, p. 1010) recognized two species, *formosa* and *gracilis*, as intermediate between these two groups. Material closely similar to typical *formosa* and *gracilis* as described has been examined, and in addition such an array of other races possessing in confusing combination the characters of these and other types, that I am unable to recognize *formosa* and *gracilis* at present, even as subspecies of *sphenops*. Regan's material listed as *M. formosa* from Tampico (*l.c.*, p. 1012) probably included specimens of both *latipinna* and *sphenops*. In the vicinity of Brownsville, Texas, Weed and Camp have taken both these species repeatedly in the same situations, but no intermediate type is represented. It is true, however, that the race of *sphenops* at this locality does approach *latipinna*.

104. *Mollienisia sphenops* Cuvier and Valenciennes

As stated above, we are not able to delimit, in either distribution or in characters, any of the multitude of elementary species making up the *sphenops* complex of Middle America. The problem of determining the relationships of these diverse types, many of which have received specific names, is in prospect a most fascinating study.

Two South American forms, apparently representative of *M. sphenops*, may be provisionally listed as subspecies of that species.

104a. *Mollienisia sphenops cuneata* Garman

Poecilia cuneata Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 62, pl. 5, fig. 3 (Turbo, Gulf of Darien).

Mollienisia cuneata Meek and Hildebrand, Publ. Field Mus., (Zool.) 10, 1916, p. 329 (after Garman).

Mollienisia sphenops Henn, Ann. Carn. Mus., 10, 1916, p. 136 (Colombia); Eigenmann, Mem. Carn. Mus., 9, 1922, p. 182 (same records).

Throughout Middle America, from southeastern Texas and Sinaloa to Costa Rica, the gonopodial characters of *sphenops* show very little variation despite the wide fluctuation in other characters. The retrorse segment at the end of the posterior branch of ray 5, and the membranous hook at the tip of ray 3, are almost invariably well developed in completely elaborated gonopodia. In Panama, these same structures show much variation, and both the retrorse segment and (to a lesser degree) the membranous hook show a tendency toward degeneration. In fact, the retrorse segment may be well developed or completely absent in specimens, otherwise alike, from the same locality.

In Colombia this variational tendency is carried to a farther degree, and here the retrorse segment seems to be seldom developed; it is not apparent in any of the twenty males examined from this region. The membranous hook also is poorly developed, and often is almost or quite lost.

Garman's name *cuneata* may be provisionally associated with these Colombian variants in *Mollienisia*. Since Panama material appears to represent intergrades between this form and ordinary *sphenops*, I adopt trinomial nomenclature.

Of this subspecies I have examined a large series from brackish water at Cartagena, Colombia, collected by Eigenmann, and smaller sets from the following fresh-waters in Colombia, collected on our Museum expeditions to the Santa Marta region: Mamatoco River, at Mamatoco; marsh north of Mamatoco; ponded outlet of Mamatoco River; irrigation ditches south of Santa Marta; an overflow pond of an irrigation ditch fed by the Tamacal River, taken on the coastal desert by Hacienda Las Flores, near Bolivar. Some of these specimens were recorded by Henn as *Mollienisia sphenops*.

104b. *Mollienisia sphenops vandepolli* Van Lidth de Jeude

Poecilia vandepolli Van Lidth de Jeude, Notes Leyden Mus., 9, 1887, p. 137; Jordan and Evermann, Bull. U. S. Nat. Mus., 47, pt. 1, 1896, p. 696; Metzelaar, Over tropisch Atlantische Vischen, 1919, p. 25.

Girardinus vandepolli Meek, Publ. Field Mus., (Zool.) 7, 1909, p. 209.

Poecilia vandepolli arubensis Van Lidth de Jeude, l.c., 1887, p. 137; Jordan and Evermann, l.c., 1896, p. 696.

Poecilia reticulata Garman, Mem. Mus. Comp. Zool., 19, 1895, p. 62 (references to *vandepolli* and *arubensis*).

Lebistes reticulatus Henn, l.c., 1916, p. 134 (synonymy excluded).

Poecilia sphenops Regan, Biol. Centr.-Am., Pisces, 1907, p. 102 (references to *vandepolli* and *arubensis* in synonymy, to Leeward islands in range, and to Curaçao and Aruba in habitat).

Range: Dutch West Indies.

Regan has synonymized *vandepolli* with *sphenops*; Garman erroneously identified it with *Poecilia reticulata* (= *Lebistes reticulatus*), and Henn, even after examining some of the specimens recorded by Meek, stated that "these agree in all respects with typical specimens of *Lebistes reticulatus* from Barbados." In addition to wide differences in size, position of dorsal fin and number of dorsal rays, in shape and coloration, there are sharp differences in the structure of the gonopodium. Like *M. s. cuneata*, this form usually shows a more or less developed membranous hook and lacks the retrorse segment, whereas in *Lebistes* the hook is wholly absent and the segment well developed.

M. sphenops vandepolli is very similar to *M. s. cuneata*, but usually differs in the development of a dark blotch approximately opposite the middle of the pectoral fin. No such spot is indicated in our specimens of *cuneata*, but it is developed in some examples of *sphenops* from Panama and Costa Rica.

M. s. vandepolli approaches *Poecilia vivipara* not only in gonopodial structure, but also in size, position of fins, general appearance and coloration. The dark bars are more conspicuous, however, and the spots on the dorsal and caudal fins more prominent (in highly colored males the spots even cover the posterior parts of the body); the lateral spot averages more advanced in position, being usually opposite the middle instead of the end of the pectoral fin; even in highly and darkly colored males the spots on the upper and lower edges of the caudal base are not developed.

In addition to the numerous specimens recorded by Meek, others, also belonging to the Field Museum, from tide-pools in Curaçao have been examined. These agree completely with the specimens from fresh-water. Metzelaar also had both marine and fresh-water material. He furthermore found that the differences which were supposed to distinguish *arubensis* from typical *vandepolli* are not constant.

Tribe 2. Alfarini Hubbs

On comparing males of the aberrant genera *Tomeurus* and *Alfaro*, it is no longer apparent that they are related. The Alfarini apparently are

placeable in the subfamily Poeciliinae, agreeing in all respects with the diagnosis of that group given on p. 10 of my 1924 paper.

Genus 51. *Alfaro* Meek

This aberrant genus may be described as follows. Lower edge of caudal peduncle a sharp keel, composed of a double series of paired scales (the analogous keel of *Tomeurus* is formed of a single series of paired scales). Jaws with a marked lateral cleft. Teeth conic and sharp, those of the outer row moderately enlarged and spaced, somewhat separated from the rather narrow band within; innermost row slightly specialized, consisting of somewhat enlarged recumbent teeth. Pelvic fins somewhat enlarged but only slightly modified in the male, the second ray only moderately thickened and elongated, not abruptly longer than the inner rays. Gonopodium short, with a prepuce-like hood; ray 3 without definite serrae; rays 4 and 5 without trace of serrae; no hook nor retrorse segment. These characters I have taken only from *A. cultratus*, not having seen *A. amazonus*.

Alfaro has been regarded as of neuter gender, but being based on a personal name, must be treated as masculine.

105. *Alfaro cultratus* Regan

Dr. Behre collected this interesting species at the following localities—Koi Creek above Coen (tributary of Rio Tilire), Talamanca Valley, Costa Rica; Fruitdale Creek along railroad spur behind Almirante, swamp draining into Cedar Creek, a tributary of Almirante Bay, San San River and tributary swamp, and right channel of Rio Cricamola below Conquantu, Panama.

106. *Alfaro amazonus* Regan

Subfamily 4. TOMEURINAE

Genus 52. *Tomeurus* Eigenmann

107. *Tomeurus gracilis* Eigenmann

Tomeurus gracilis Eigenmann, Ann. Carn. Mus., 6, 1909, p. 53; Rep. Princeton Univ. Exp. Patagonia, 3, 1910, p. 461; Regan, Proc. Zool. Soc. London, 1913, p. 981; Eigenmann, Mem. Carn. Mus., 9, 1922, p. 460, pl. 65, figs. 6, 7.

On examining the types of this species, the writer was again impressed at the large amount of bizarreness concentrated in so small a fish.

PLATE I

Comparison of gonopodia of Gambusiini and Heterandriini

Figure 1. Distal portion of the gonopodium of *Gambusia puncticulata*, from a specimen 26 mm. long to caudal fin, from Havana, Cuba. Note the terminal hooks (*t h*) and elbow.

Figure 2. Distal portion of gonopodium of *Heterandria formosa*, from a specimen 12.5 mm. long to caudal fin, from De Leon Springs, Florida. Note the absence of terminal hooks and elbow.

The rays of the gonopodia are numbered (3, 4 and 5), and the anterior and posterior branches of ray 4 are lettered (*a* and *b*). The posterior branch of ray 5 is not shown in either figure; that of *Gambusia puncticulata* is similar to that of *G. nicaraguensis* in location, termination, and character of segments (see next plate). The dilated anterior branch of ray 5 in the *Heterandria*, as shown in the figure, includes both the left and right halves of this branch.

See pages 19-35, 37 and 55.

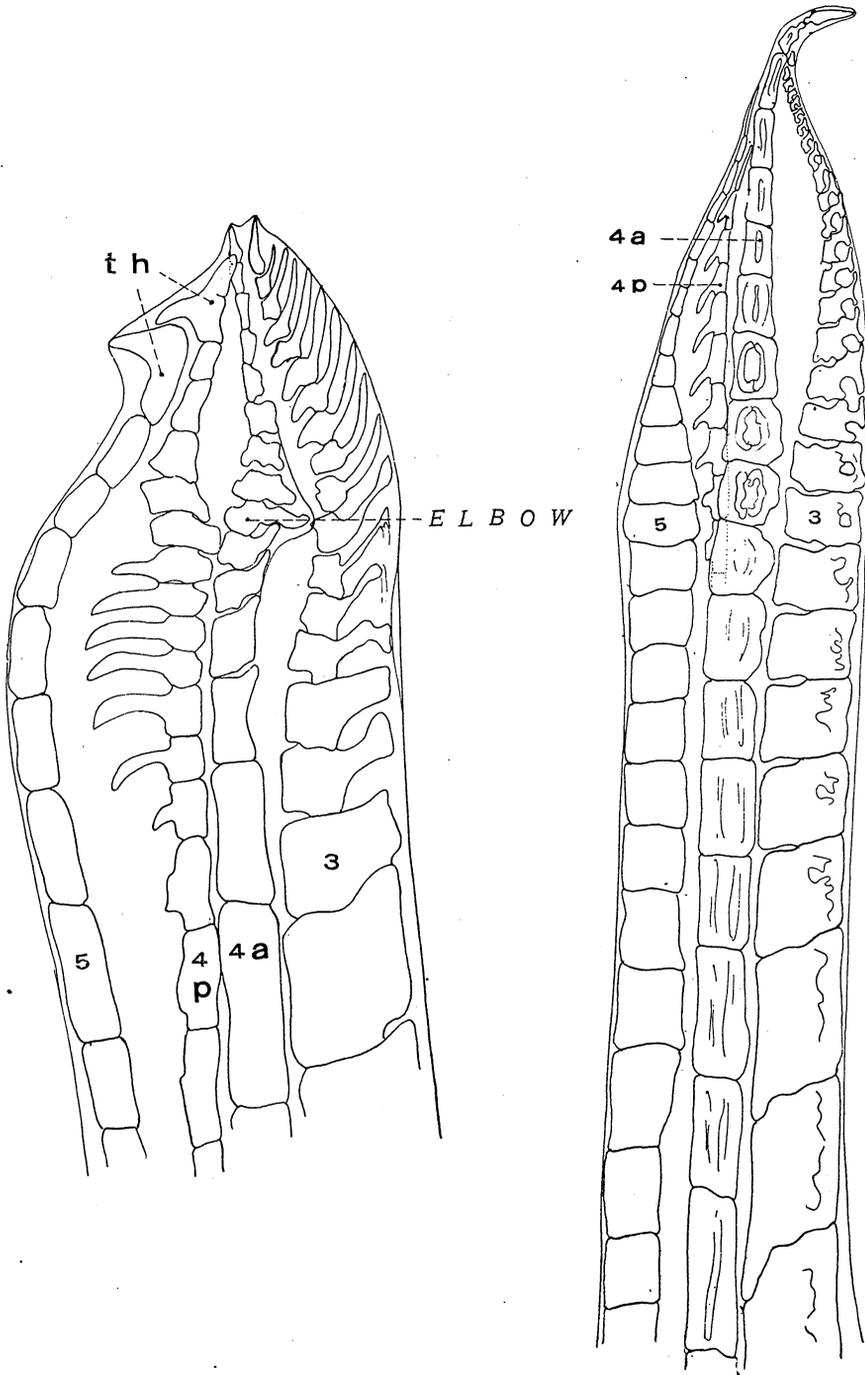


PLATE II

Gonopodia of *Gambusia nicaraguensis*

Figure 1. Entire gonopodium of a specimen 18 mm. long to caudal fin, from Rio Hueyapam at San Juan, Acayucan, Mexico.

Figure 2. Tip of gonopodium of the same specimen, further enlarged.

Figure 3. Tip of gonopodium of another specimen from the same locality. Length to caudal, 16.4 mm.

The rays of the gonopodium are numbered (1 to 9) and the anterior and posterior branches of the rays lettered (*a* and *p*). The terminal hooks are indicated by the letters *t. h.*

See pages 21-23 and 34-35.

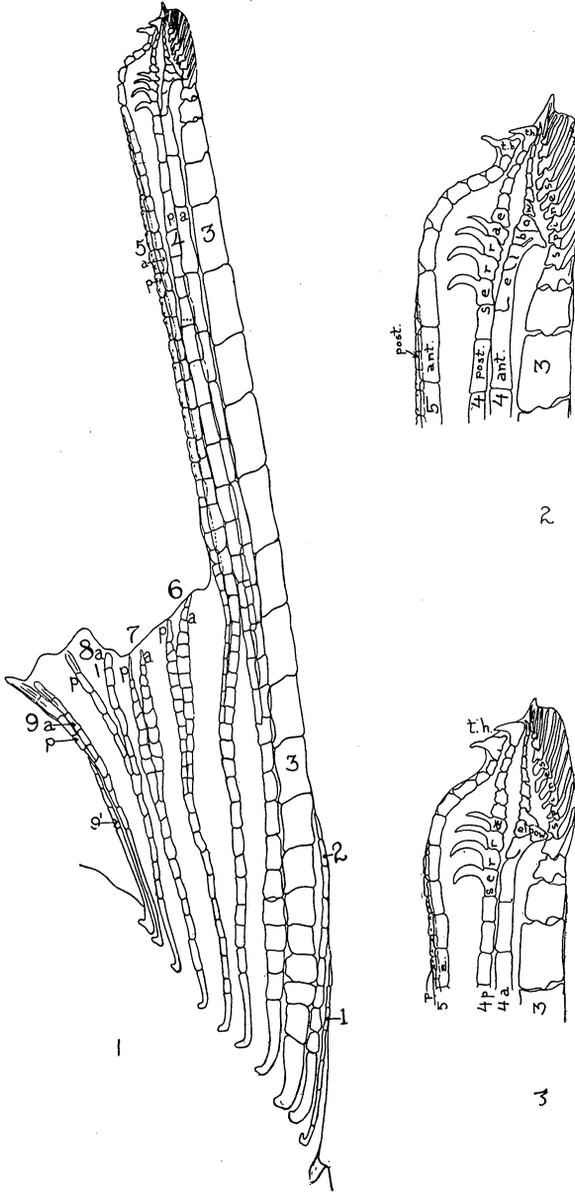


PLATE III

Gonopodia of subgenera *Arthropallus* and *Schizopallus*

Figure 1. Distal portion of the gonopodium of *Gambusia (Arthropallus) patruelis*, from a male 21 mm. long, collected at Huntsville, Alabama.

Figure 2. Distal portion of the gonopodium of *Gambusia (Arthropallus) patruelis*, from a male 22.3 mm. long, taken at Tampico, Mexico.

Figure 3. Gonopodium of a specimen of *Gambusia (Schizopallus) holbrookii* 25 mm. long to caudal fin, from Augusta, Georgia. Note that ray 3 is branched, the point of bifurcation being indicated by the dark arrow. In the specimen selected for illustration the two branches are entirely separated. Normally the branches are partially imbricated, so that the anterior edge of the posterior branch appears as a ridge on the anterior branch.

Legend: see explanation of Plate II.

See pages 25 and 38-41.

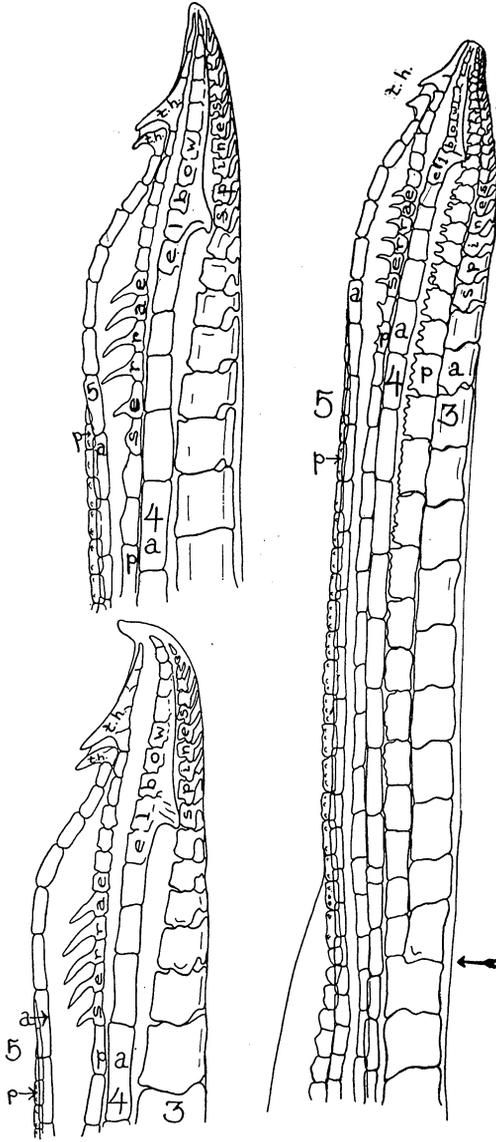


PLATE IV

Gonopodium of *Belonesox*

Gonopodium of a specimen of *Belonesox belizanus* 59 mm. long to caudal; collected in Rio Hueyapam, in Acayucan, Mexico.

Legend: see explanation of Plate II. The thorn-shaped incisions of the anterior branch of ray 5 are indicated by *inc.*

The extreme tips of rays 3 and 4 in the specimen figured are twisted out of their natural position.

See pages 20, 25-26 and 41.

