

MISCELLANEOUS PUBLICATIONS
MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN, NO. 78

STUDIES OF CYPRINODONT FISHES.
XX. A NEW SUBFAMILY FROM
GUATEMALA, WITH CTENOID
SCALES AND A UNILATERAL
PECTORAL CLASPER

BY
CARL L. HUBBS

ANN ARBOR
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MAP

MAP

PAGE

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STUDIES OF CYPRINODONT FISHES. XX. A NEW
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INTRODUCTION

BIZARRE novelties continue to appear in the Cyprinodontes (Microcyprini). As late as 1940 a new family was discovered in India (Kulkarni, 1940; Hubbs, 1941). The latest such discovery to come to my attention is that of a genus, from the interior of Guatemala, which is referable to the American viviparous family Poeciliidae but is so unique in three respects as to call for its segregation in a separate subfamily.

XENODEXIINAE, NEW SUBFAMILY

Type genus, *Xenodexia*, described below.

The Xenodexiinae are unique among fishes in the extreme specialization of one pectoral fin (Hubbs and Hubbs, 1945: 294-95). In the adult male the axillary region of the right pectoral fin (Pl. II, Figs. 2-3) is spectacularly modified into a very complex structure, presumably of some copulatory function, whereas the left fin remains unmodified. In some ways this pectoral clasper is comparable with the pelvic claspers (myxopterygia) of the Elasmobranchii. Some flatfishes (Heterosomata) have one pectoral fin, that of the blind side, reduced in size and in number of rays, or even completely obsolete (Hubbs and Hubbs, 1945: 254-63), but in no known group are the pectoral fins modified differentially in basic structure for clasping, or for any other function, and in none, with the possible exception of the remarkable Phallostethidae, are the pectoral girdles so modified. If Bailey (1936: 475) was correct in interpreting the toxactinium in some Phallostethidae and the pulvinulars in others as homologs of a pectoral girdle structure (the alternative suggested homology with detached lower pectoral rays seems wholly improbable), that group would also show an asymmetrical secondary-sexual modification of the pectoral limb, for the priapial structures mentioned are unpaired. No close relationship, however, can be postulated between the Phallostethidae and the Xenodexiinae or any other division of the Cyprinodontes (Myers, 1928; Hubbs, 1944: 74-75, with other references).

The Xenodexiinae are unique among the Cyprinodontes in the ctenoid structure of the scales (Pl. III). This discovery, though surprising, is in

¹ Contributions from the Scripps Institution of Oceanography, New Series, No. 485.

harmony with the varied evidence that the Cyprinodontes are more advanced in teleostean evolution than are the Haplomi and that they are closely related to the Acanthopterygii and possibly even derivable from that group (Regan, 1911: 321; Hubbs, 1920: 67, 1924: 3-4, 1944: 75; Myers, 1928: 3-4; Gregory, 1933: 216-20; Boldyreff, 1935; Lagler, 1947: 160). Particularly unexpected is the discovery of ctenii on a fish that appears to represent a terminal modification of the specialized viviparous family Poeciliidae. There is some evidence that many, possibly all, "lower" teleosts with cycloid scales had ancestors with ctenoid scales. This view, which I have held for some years, has been mentioned briefly by Lagler (1947: 159).

Since it is hardly conceivable that the typically ctenoid scale of *Xenodexia* was independently evolved,² we are confronted with a series of alternative explanations for the retention of ctenii in this genus: (1) One alternative is that *Xenodexia* is the sole known surviving genus of a line that was derived from an ancestral cyprinodont with ctenoid scales. This line might have branched from a very primitive cyprinodont, on which assumption the ctenii may have been lost but once in the Cyprinodontes; or from an ancestral poeciliid, on which hypothesis one would infer repeated loss of the teeth on the scales, since other families, including the more primitive Cyprinodontidae, also lack ctenii. The fact that *Xenodexia* is highly specialized in some respects does not argue strongly against this view, for, as I have repeatedly pointed out, primitive and specialized characters are very commonly if not usually combined; that is, existing relicts of primitive groups are usually highly specialized in some respects, and many highly specialized types retain some primitive characters. I disfavor this first alternative, however, because there is strong support for the view that *Xenodexia* is a highly modified poeciliid.

If *Xenodexia* is a specialized member of the Poeciliidae, two further alternatives remain: (2) The ctenii may have been retained throughout the complex ancestry of the genus but lost in every other line of cyprinodont evolution. This idea overtaxes the concept of parallel degenerative evolution, especially in view of the indications that the whole group, the Poeciliidae in particular, is relatively recent and actively proliferating. (3) Finally, *Xenodexia*, as a highly modified poeciliid, may have regained a very specialized structure that was long lost in the phylogeny of the group. The total evidence seems to support this explanation. The loss might have been only in the phenotypic expression of the character, as the result of a prolonged suppression of the effects of genes that nevertheless persisted. Such apparent exceptions to the law of irreversible evolution do seem to

² The possibility of independent evolution of ctenii in *Xenodexia*, at first given some credence, before the structures were studied in detail, was presented briefly by Lagler (1947: 160).

occur. To cite a parallel case, the development of teeth in only one living anuran is most plausibly attributed to the renewed expression of the causative genetic mechanism (Cornman, 1943). Another case, involving the abnormal appearance in the modern dog of the long-lost third upper molar, has been cited by Wood and Wood (1933).

Whether it be assumed that *Xenodexia* originated from near the root of the order, or from near the base of the family, or from a specialized branch of the Poeciliidae, the asymmetrical modification of the pectoral fin and the ctenoid structure of the scales provide ample need for recognizing it as the sole known representative of a distinct group, which I interpret as of subfamily rank.

The third character of the Xenodexiinae, much less distinctive, is the broad extension of the coelom into the urosome over the entire base of the anal fin (Pl. IV), causing the very short interhemals of the female to project into the body cavity, far removed from the vertebral column. The corresponding vertebrae in both sexes carry ribs (and, apparently in part also, parapophyses), but in the female they do not bear hemal spines.

The backward extension of precaudal-type vertebrae into the urosome in *Xenodexia* may be considered merely a further step in a process already begun in all Poeciliidae and carried far in some genera. In *Alfaro* and *Furcipenis* the air bladder penetrates about as far into the urosome, but in these genera the female retains hemal spines in the position of the gonapophyses of the male (Howell Rivero and Hubbs, 1936).

Despite its ctenoid scales and other distinctive features, there can be no hesitation in referring *Xenodexia* to the Cyprinodontes. Every other observable feature is in harmony with this reference.

The pertinence of the Xenodexiinae to the Poeciliidae seems almost equally certain, for the fundamental characters are those of that family. Like other poeciliids *Xenodexia* is viviparous, with greatly reduced fecundity. As in all other members of the family the ovary is a single, thin-walled sac. As in all other genera the anal fin of the male is elaborately modified into an intromittent organ (Pl. I), the gonopodium, comprising rays 3 to 5 and supported by a complex suspensorium (Pl. IV, Figs. 1-2), in the basic structure highly distinctive of the family. The main osteological features of the gonopodial suspensorium in *Xenodexia*, as in other poeciliids, are the extreme specialization of the interhemals and the profound modification of the connected vertebrae (Howell Rivero and Hubbs, 1936). The anterior interhemals, from the second to the fifth or sixth, are much enlarged, thickened, and consolidated to comprise the rodlike compound interhemal, which with its investing muscles projects into the body cavity. The posterior interhemals, much less modified but considerably clumped, are connected with the vertebral column by two or more curved

or angulated bony spines. These unique structures are almost certainly to be homologized with hemal spines, though they are often unrepresented or incompletely represented in the female. In fact, none of the many modifications of the gonopodial suspensorium are evident in the female or in the young.

The xenodexiines further agree with the Poeciliidae in two nonsexual features, recently determined, by which all poeciliids differ from the oviparous Cyprinodontes: (1) The third anal ray, reaching nearly to the pointed tip of the fin, is unbranched. This ray is branched in all oviparous forms, except in some young and in the species with a low, anteriorly rounded anal fin. (2) In addition to the lateral-line organs typical of the whole group (those on the axial scale row of the urosome and those on the next higher row on the trunk), neuromasts or pit organs, one of which is shown on Plate III, occur in the following places: on the second scale row above the series along the ventral edge of the caudal peduncle, along the first row of large scales above the anal base, and on the breast. In the oviparous cyprinodonts neuromasts do not occur in those regions, except in the very few species in which the organs follow all scale rows. Incidentally, these characters permit the identification to family of series of American cyprinodonts that are represented only by immature specimens.

The two outstanding characters of the subfamily Xenodexiinae, the highly modified right pectoral fin and the ctenoid scales, are reflected in the etymology of the generic and specific names: *Xenodexia* comes from ξένος, (strange) and δεξία (right hand); *ctenolepis* from κτερίς (comb), λεπίς (scale).

Xenodexia, new genus

Genotype, *Xenodexia ctenolepis*, new species.

In addition to the three features stressed in the subfamily description, various characters separate *Xenodexia* from any of the previously known genera of Poeciliidae. Following the sequence of characters in "An Analysis of the Genera of the Poeciliidae" (Hubbs, 1924: 7-11), the new genus may be further diagnosed as follows: Lower edge of caudal peduncle rounded, with a median series of normal scales. Pelvic fins alike and well developed in both sexes and inserted behind the base of the pectorals. Rays of gonopodium imbricated so as to form an imperfectly closed tube. These characters lead to the Poeciliopsinae, from which *Xenodexia* may well have been derived.

Following the revised analyses of the poeciliopsine genera (Hubbs, 1926: 63-64; 1936: 232-35), these characters may be added: Mouth with lateral cleft much reduced and with the tooth series nearly transverse, slightly hooked backward at sides. Dentary bones soft, but rather tightly conjoined. Teeth strictly uniserial, subvertical, moderately flattened, and in-

curved, loosely attached to jaw (but not hairlike). Intestine elongate, coiled on the right side. Gonopodium without hornlike appendages; ray 4 not forming a definite hook at its tip; ray 5 apparently not extending to extreme tip of organ; tube fundamentally on the right side (wholly on the right side in developing male, but at the base and tip only in adult male, in which most of the tube is twisted to the left side by the rolling of the right side of ray 3 over the upper edge of the gonopodium); no obvious antrorse serrae on ray 4. Body slender and scarcely modified for surface swimming (p. 11). Dorsal and anal fins originating on approximately the same vertical (in female). Dorsal fin short (with 9 rays) and moderately rounded. Except for discrepancies in the position of the tube of the gonopodium, in the relative position of the dorsal and anal fins, and in the number of dorsal rays these characters lead toward *Poecilistes*, which, conceivably, might have been ancestral to *Xenodexia*. There are numerous other differences in the detailed structure of the gonopodium (p. 18).

Whether *Xenodexia* is phyletically related to *Poecilistes* or to any other genus of the Poeciliopsinae is problematical, in view of the profound differences noted in the subfamily discussion. It certainly does not line up with the Alfarinae (Howell Rivero and Hubbs, 1936) or the Poeciliinae (Hubbs, 1924: 10-11; 1926: 72-73) and presumably was derived from neither of those specialized groups. If the tubular gonopodia of the Xenodexiinae and the Poeciliopsinae were derived independently, the new group may have stemmed from the Gambusiinae, but if so from what gambusiine genus is not obvious. Origin from the Poeciliopsinae would explain the superfetation practiced by *Xenodexia* (p. 24), for superfetation is particularly characteristic of the poeciliopsines.

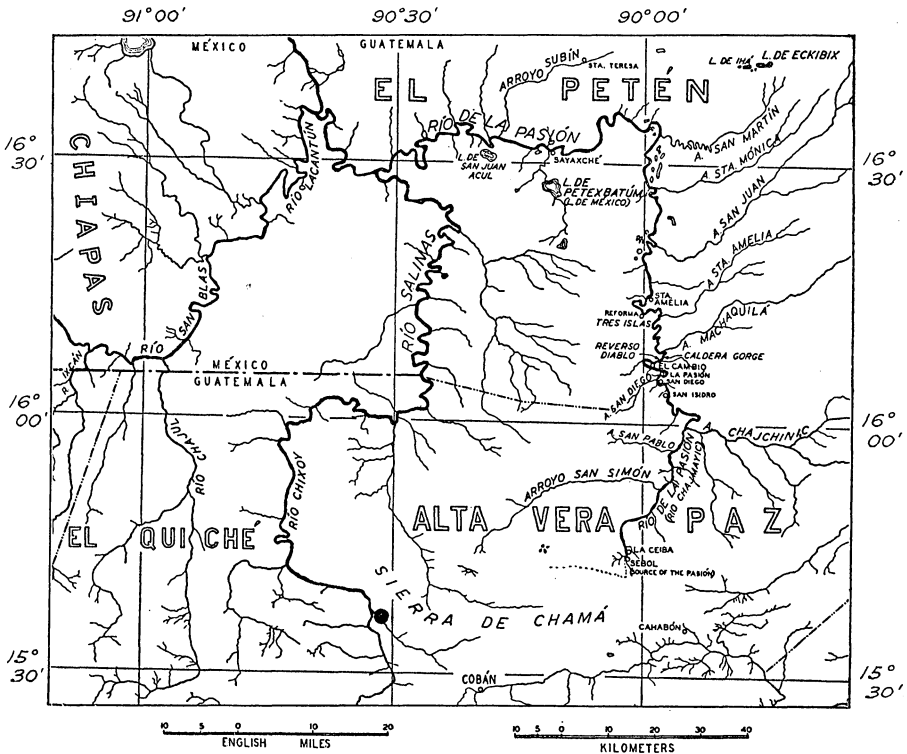
Xenodexia ctenolepis, new species

(Pls. I-IV; Map 1)

TYPE LOCALITY AND HABITAT

This species is known from a single series of 40 specimens seined by L. C. Stuart in Río Seniso (Río Salba), at Finca Chamá, Guatemala, from the hacienda to the mouth of the stream. The locality is about 30 kilometers northwest of Cobán (Map 1). Río Seniso is a small tributary to the deep canyon section of Río Negro (Río Chixoy), which lower down becomes Río Salinas. Río Salinas and Río de la Pasión then unite to form Río Usumacinta, which is perhaps the largest river of Central America.

At the type locality of *Xenodexia ctenolepis*, according to the collector's notes, the Río Seniso is a clear, warm stream about 50 meters wide and as deep as 5 meters (seining was limited to depths less than 1 meter). It flows slowly to swiftly over a gravel bottom between high banks in the rain forest. There is "occasionally a little bottom moss."



MAP 1. Part of Guatemala, showing (black dot) the type locality of *Xenodexia ctenolepis*.

FISH ASSOCIATES AND ZOOGEOGRAPHY

With the types of *Xenodexia ctenolepis*, Stuart collected:

Asytanax fasciatus, intergrades between *A. f. aeneus* (Günther) and the more northern *A. f. mexicanus* (Filippi) (subspecies *aeneus* abounds throughout lower reaches of the Usumacinta system): 24 specimens.

Mollienisia sphenops chisoyensis (Günther, 1866: 342), a dwarf up-stream form quite unlike *M. s. macrura* Hubbs (1935: 12-13, Pl. 2, Figs. 2-3) of rivers lower in the Usumacinta system: 165 specimens.

Xiphophorus hellerii guntheri Jordan and Evermann, a rather distinctively colored local form, named by Jordan and Evermann (1896: 702) on the basis of a color sport reported as *Xiphophorus hellerii*, var. γ by Günther (1866: 350; 1869: 485-86, Pl. 87, Figs. 3-4) from a locality close to Río Seniso: 6 specimens. Although the color phase is not worthy of a name, the local form it represents seems to be, for Günther's Figure 2 of a normally colored specimen from the same locality is matched by the specimens from Río Seniso and is unlike specimens from any of the many other localities represented in the Museum of Zoology.

"*Thyrina*" species (seemingly endemic) : 5 specimens.

Cichlasoma species (seemingly endemic) : 9 specimens.

From the foregoing list it will be seen that *Xenodexia ctenolepis* inhabits a region with a limited though endemic fish fauna. The contrast is striking with the fauna of the lower parts of the Usumacinta system in El Petén, which I reported in small part early in 1935 and explored later in the same year. It seems unlikely that *Xenodexia* is of wide distribution, for recent collecting in the higher headwaters of the Usumacinta system by Robert R. Miller yielded no additional specimens. Nor did he secure any specimens of the other endemic species of the fauna, of which it is the most notable element.

TYPE SPECIMENS

The 40 type specimens were all collected by L. C. Stuart on May 22, 1931, and were preserved in 10 per cent formalin. Because of transport on muleback the delicate fins are mostly broken, but otherwise the specimens are in good condition. The holotype (U.M.M.Z. No. 105460) is an adult male 40 mm. in standard length. The 39 paratypes (U.M.M.Z. No. 105459) comprise 6 immature males 21 to 23 mm. long, 31 immature females 19 to 32 mm. long, 1 maturing female 39 mm. long, and 1 mature female 41 mm. long.

DESCRIPTION

Counts of fin rays, scales, gill rakers, and head pores are analyzed in Table I. Measurements are recorded in Table II.

Form of Body and Head

In the female the dorsal and ventral contours form almost mirror images of one another. The breeding male has a straighter anterodorsal contour, the muzzle is more downcurved, and the axis is slightly angulated. In these respects the body form of the male slightly approaches that of the surface-swimming cyprinodonts. The male is also somewhat more oblong in shape, due not only to the flattened anterior profile but also to the longer and deeper caudal peduncle. In both sexes the dorsal contour is very obtusely angulated at the front of the dorsal fin. In the male the body is considerably more compressed and flat-sided than in the female: its greatest width is about one-half, rather than about two-thirds, the distance between the origins of the dorsal and anal fins. The greatest depth, near the middle of the trunk, is nearly one-fourth the standard length in the adult female, but only one-fifth that length in the mature male.

In both sexes the head is nearly as wide as deep. The head is considerably shorter, slenderer, and blunter in the adult male than in the adult female. The eye is large and, especially in the male, close to the dorsal contour. When viewed from in front the sides of the head converge down-

ward: the distance between the eyes at the lower border is only two-thirds the interorbital width. The preorbital is narrower than the pupil.

Mouth, Gill, and Intestinal Structures

The mouth is about 0.7 as wide as the interorbital. It is almost strictly transverse as seen from above. Viewed from the side, it is sharply angulated, becoming almost vertical when the mouth is tightly closed. The lateral gape is a little more than one-fourth the transverse width of the mouth. The flat mandibles are almost in contact along the mid-line. Their outer edges converge backward. The maxillaries are separated ventrally by a distance only 0.6 the width of the mouth. The lips are thin; the upper is hardly one-fifth as long as wide.

TABLE I
ANALYSIS OF MERISTIC VARIATION IN TYPE SERIES OF *Xenodewia ctenolepis*

Character	No.	Range	Mean	SD	SE	Holo- type
Dorsal rays*	40	8-9	8.97	.16	.02	9
Anal rays*	40	10-11	10.40	.49	.08	10
Caudal rays†	16	16-17	16.06	.25	.06	16?
Pectoral rays (both fins)‡	60	13-15	13.93	.18	.02	14-14
Pelvic rays (both fins)	58	6-6	6.00	.00	.00	6-6
Scales (transverse rows)	40	32-34	32.87	.56	.09	33
Gill rakers on first arch	4	15-17	15.75
Preopercular pores at stated size groups:§						
19 to 25 mm.	44	6-7	6.25	.43	.07
26 to 32 mm.	28	7-7	7.00	.00	.00
34 to 41 mm.	8	7-7	7.00	.00	.00	7-7
Preorbital pores at stated size groups:§						
19 to 25 mm.	44	0-3	0.30	.84	.13
26 to 32 mm.	28	3-3	3.00	.00	.00
34 to 41 mm.	8	3-4	3.87	.36	.13	4-4

* Total number of rays, counting the last 2 elements as one ray.

† Principal rays (branched rays plus 2). Owing to injury of the fin, half of the counts are questionable.

‡ Both fins were counted. The count includes a short ray at the upper edge of the fin and all discernible rudiments at the lower end.

§ Standard lengths. The pores were counted on both sides. Neuromast pits or grooves without pores were not counted.

The amber teeth form a single series, with only slight irregularities in the file. Across the mid-line in each jaw the series is slightly bent backward, but is nearly continuous. Each series is slightly hooked around the corner of the mouth, but is scarcely extended onto the lateral gape. The teeth are subvertical, moderately strong and firm, somewhat flattened medially, not very sharply pointed, moderately curved backward.

The gill membranes are narrowly connected by a free fold located on a

vertical approximately below the posterior edge of the preopercle. The upper limb of the first gill arch is attached to the roof of the mouth. The rather sharp gill rakers extend slightly onto the skin surface over the base of the upper arch.

The intestine has a smaller caliber than in *Poecilistes* and is longer and more extensively coiled (Pl. IV). There are about 5 coils. The outside diameter of the largest coil is one-third the standard length, instead of one-fourth as in *Poecilistes*. Posteriorly this coil extends to a vertical that intersects the ventral contour at a point twice as far from the pelvic insertion as from the anal origin, rather than as in *Poecilistes*, at a point little be-

TABLE II
MEASUREMENTS OF *Xenodexia ctenolepis* EXPRESSED IN
THOUSANDTHS OF STANDARD LENGTH

	Adult Male (Holotype)	Mature Female	Maturing Female	Immature Females (7)	
				Range	Mean
Standard length, mm.	40.1	40.5	39.1	28-34	30.6
Body depth	227	228	221	193-219	209
Caudal peduncle depth	145	132	130	125-131	127
Predorsal length	553	581	582	572-592	583
Prepelvic length	434	452	442	439-455	446
Anal origin to caudal base	512	420	437	421-439	429
Head length	220	238	243	249-263	255
Head width	135	146	140	147-158	150
Head depth	141	157	156	159-167	164
Snout length	54	75	75	72-77	75
Orbit length	81	82	84	83-91	86
Postorbital length	88	95	97	101-108	104
Fleshy interorbital width	85	110	114	102-118	113
Mouth width	61	76	75	74-79	77
Fin lengths:					
Dorsal base	117	106	107	99-110	105
Depressed dorsal	Injured	207	211	183-220	207
Depressed anal	438	175	187	174-192	182
Caudal (middle rays)	Injured	Injured	224	207-241	227*
Pectoral	219	185	Injured	Injured
Pelvic	Injured	142	135	131-149	139†

* Based on 3 measurements.

† Based on 6 measurements.

hind the pelvic base. As is usual, the coils of the intestine lie against the right body wall.

Axial Skeleton

Except for special modifications attributable to the great extension of the coelom into the urosome, in both sexes, and to the elaboration of the gonopodial suspensorium, in the adult male, the axial skeleton, as seen in the X-ray photographs (Pl. IV) and in partial dissections of the maturing female, is of the typical poeciliid type. Including the hypural the verte-

brae number 34. The axis bears no ribs and apparently no neural spine. It is tightly secured to the skull by a suture that is oblique and angulated laterally. Each of the other vertebrae bears a neural spine and, in each sex, the last 16 vertebrae in advance of the hypural appear from the X-ray photographs to bear similar, scarcely modified hemal spines. On partial dissection, however, the first 3 of these structures in the female are seen to be spread apart at the base, the first almost completely, the third slightly, to surround the tip of the air bladder. In the X-ray photographs of the adult male (reproduced as Pl. IV, Figs. 1-2), the first of these 3 ventral processes is seen to be highly modified and the next 2 show some basal modification (p. 21). Therefore, there are not more than 14 fully typical caudal vertebrae in advance of the hypural.

The first 11 ribs of each side (in the female overlying the gut) are strong. The first rib, borne by the second vertebra, is the least oblique. On the thirteenth to the sixteenth vertebrae there follow 4 more pairs of ribs, decreasing in length and thickness. One or 2 additional, rudimentary pairs may exist.

Vertebrae 13 to 19, therefore, show transition from the precaudal to the caudal type, with the thirteenth little modified. In the female, vertebrae 14 to 18, which carry strong gonapophyses in the adult male (p. 21), do not bear normal hemal spines, but grade from a nearly typical precaudal vertebra, with scarcely developed parapophyses, to one in which parapophyses barely unite.

Individual vertebrae are of slender hourglass shape, decreasing in length but not in sutural height toward the hypural. The hypural is of the typical homocercal type. There appears to be some heavy calcification a short distance behind its front suture. Four vertebrae in addition to the hypural support the caudal fin.

Scales

As already indicated, the scales of *Xenodexia ctenolepis* are unique among cyprinodonts in being ctenoid (Pl. III). The spines near the scale margin are not to be confused with the cilia-like nuptial organs of the breeding male of some oviparous cyprinodonts (Newman, 1909). They are present in females as well as males and in young as well as adults. They are hard, needle-sharp, denticle-like structures, quite like the ctenii of acanthopterygian fishes. They form near the straightish scale margin and remain essentially uniserial, though the upper and lower ones are seen on close examination to belong to a row behind the series that occupies the middle half of the denticulate border. Presumably the penultimate row increases in height at the dorsal and ventral ends, but, before the process is completed, is followed medially by a new row. The ctenii of the next to last row are represented only by the bases in the median part of the row,

opposite the developed part of the last row. Still farther forward even the bases disappear, as they become completely overgrown by the outer layers of the scale. This process of overgrowth appears to begin almost as soon as the etenii are first formed. After the etenii begin to develop, when the scale is about one-fourth the adult size, the posterior field grows very little. In the adult the etenii-bearing, posterior field is only about one-fourteenth as long as high, and the entire posterior field from the center of the focus is only about one-sixth as long as the height of the denticulate part of the scale border. The length of the anterior field of the scale, in contrast, is about one-half the height of the entire scale. The whole scale is about two-thirds as long as high. Circuli near the focus and on the lateral fields are rather coarse. In the region of the etenii there are no circuli. Between the etenii and a slight groove bounding the lateral fields proper there is a narrow band on which there are traces only of circuli. On the anterior field the circuli are about twice as crowded as on the lateral fields. The weakly angulated anterior border is about one-fourth higher than the posterior border. The moderately divergent radii number about 12 in the half-grown and about 15 in the adult. Between the radii most of the segments of the circuli are curved backward.

The teneid scales cover most of the body, but the etenii are lacking on the scales of the head and the immediately adjacent parts of the body. The spinules are either weak or absent on the scales of the breast and pectoral fin base and often on a few body scales near the caudal base.

The arrangement of the scales on the body is quite typical of the cyprinodonts. The axial scale row is slightly bent upward anteriorly, to overlie throughout the axial septum of the body-wall muscles. This row is separated by 3 parallel rows from the middorsal row, which is split by the dorsal fin, and by 3 rows from the median ventral series of the caudal peduncle (close to the head only 2 rows may intervene between the axial and middorsal rows; on the abdomen the highly regular arrangement breaks down). This pattern of lepidosis was found, by an examination of the nearly complete range of species in the Museum of Zoology, to characterize all Poeciliidae with one minor exception: in the deep-bodied forms of *Mollienisia*, as *M. velifera* Regan and *M. sphenops altissima* Hubbs, 4 rows intervene between the axial series and the row on the ventral edge of the peduncle. The same pattern characterizes many of the oviparous cyprinodonts as well.

There is some modification of the scales near the bases of the fins, including the pelvic (p. 18). The scales at the anal base are slightly modified, especially at the gonopodial base on the right side (p. 21). There is a large thick scale on the upper anterior part of the broad pectoral base. It is separated from the scaleless fin base by a row of moderately large scales and then by several small thin scales, which on the right or clasper side of

the mature male become thickened to form a definite hard rim. This rim closely overlies a rather deep pocket and is continued along a rounded lobe well below and behind the lower end of the pectoral base. The arrangement of scales on the right pectoral base is shown in Plate II, Figure 3.

Fundamentally, the lepidosis of the head is also typically cyprinodont, but some of the details are probably distinctive. The scales on the top of the head are large. The nonimbricate scale is one of a pair that nearly covers the posterior half of the interorbital space. This pair of scales is bounded behind by a large median scale and 2 smaller lateral ones. The median scale makes contact with the first dorsal body scale and thus excludes a pair of large scales from the mid-line. In front of the 2 interorbital scales mentioned above there is a large shield-shaped scale. In front of this scale are 2 medium-sized scales and in front of these, 2 near the mid-line and 1, occasionally 2, at the side. There are 3 small scales on each side of the interorbital. Three large scales carry the axial row of the body forward to behind the upper posterior corner of the eye, and about 3 scales separate them from the enlarged scales on top of head. The axial row is separated by a row of 3 or 4 thin scales from the opercular scales. On the opercles there is a subvertical row of 3 very large scales, followed by a submarginal row of 2 to 4 usually smaller scales and preceded, behind the rounded preopercular angle, by a row of 2 to 4 small scales. On the cheek there are 4 to 6 small thin scales along the lower and lower-posterior margin of the orbit and 2 to 4 extra scales between this row and the preopercular angle. The muzzle and the lower anterior side of the head are scaleless.

Lateral-line Structures

As in other Poeciliidae typical lateral-line pores are not developed, but are represented by neuromast or pit organs (Pl. III), 1 to each scale, aligned in a pattern distinctive of the family (p. 8). Anteriorly, the organs disappear in the axial series but are developed instead on several scales of the next higher row. There are very few of these pits on the dorsal part of the body. The series along the second scale row above the midventral line of the caudal peduncle is incomplete. The pits occur also on the larger scales above the bases of the anal and pelvic fins and on many of the scales of the breast.

On the head the arrangement of the organs is of the cyprinodont type (Gosline, 1949). There is nothing in its canal and pore pattern to set *Xenodexia* sharply apart from many other genera, particularly in the Poeciliidae. In the adult, above and behind the eye, there is a short segment of lateral line with a pore at either end. Just mesad to this there is a rather indefinite structure. There is a short canal on each side of the interorbital along either side of the large median scale. Closer to the

mouth there is a well-separated pair of short grooves, each of which in the adult becomes covered to form a tube with a pore at each end. The preorbital canal is gently curved, paralleling the orbit. It is open and without pores in the young, but, as indicated in Table I, gradually becomes covered with membrane, leaving 3 pores in the half-grown and usually 4 in the adult. When there are only 3 pores, there is usually a neuromast organ below, that may or may not lie in the same fossa as the lowest pore. Occasionally, when 4 pores are developed in the adult, there is still a neuromast organ below. When there are only 2 openings the median pore (to be) is connected with the one either below or above. The infraorbital canal has no pores, but is represented by a row of very small, close-set sense organs. The preopercular canal is a closed tube with 7 pores in the adult, 3 above and 3 in front of the angle. In the smaller specimens examined, the 2 upper pores are united so as to give a count of 6 (Table I). Anteriorly in the same series there is on each side a rather indefinite sense organ just inside the maxillary and a somewhat similar structure, also without a definite pore, on the chin. On each side of the opercles there are 4 small, low, slightly recessed sensory papillae, arranged as shown on Plate I.

Coloration

The coloration is rather plain and is essentially alike in male and female. The young are much like the adults, except that the lateral band is narrower and less intense. The advanced embryos (p. 24) differ from the 20-mm. young in several respects, particularly in the double file of melanophores along the lower edge of the caudal peduncle and along the middorsal line. The development of pigmentation is briefly traced on page 24.

The most prominent color markings are the dark lateral band and the dark margining of the scale pockets. The lateral band, extending from an indefinite origin near the middle of the trunk to but not onto the base of the caudal fin, is an intense suffusion about the fine black axial streak. The dark scale-pocket borders are broad and intense near the back, are narrow but remain conspicuous on the mid-sides, become faint near the lower edge of the urosome, and disappear on the belly and breast. The scale pockets in the temporal region retain the dark border and the light centers, but the parietal-occipital region is dark. The top of the muzzle is somewhat variegated. There is a rather indistinct dark streak on the head behind the eye, but below this mark and below the blackish transverse parts of the lips the head is pale. Except for a fine black streak on each edge of the dorsal, anal, caudal, and pectoral rays, the fins are whitish. Most of the processes of the pectoral clasper are punctulate. There are also some fine specks on the gonopodium, on the rolled-over part of ray 3.

My recollection is that the lower sides of the specimens, when fresh, were more or less yellowish, definitely yellow in the adult male.

Fin Structure

The basic fin structure is typical of the cyprinodonts. The dorsal fin includes 2 unbranched rays. The first is about half as long as the second, which extends nearly to the tip of the fin. The 7, occasionally 6, other rays are branched. The anal fin of the young and the female comprises 3 unbranched rays (the first very short, the second moderately short, and the third extending nearly to the tip of the fin) and 7 or 8 branched rays. There are 15, occasionally 16 branched caudal rays (16 or 17 principal), and, in addition, above and below, 1 or 2 rather well-developed marginal rays and several small procurrent ones. The pectoral comprises 1 short and 1 long simple ray and 11 to 13 branched rays. The pelvic has 1 unbranched and 5 branched rays. All rays except the very shortest procurrent caudal rays are articulated.

The dorsal fin varies from rounded to rather sharply pointed. The caudal fin is truncate. The pectoral is moderately rounded; the pelvic, pointed. In the adult female the pectoral reaches almost to the vertical from the pelvic insertion; the pelvic, to the anus or to the genital opening. The pelvic fins are essentially alike in the two sexes, as are also the pectoral fins proper, despite the profound modification in the adult male of the pectoral fin base on the right side. The pelvics are widely separated by a basal interspace about thrice as wide as either fin base. Between the base of the fins there are 3 scales, of which the outer one on each side overlaps the fin base, but there is no special sheath of scales, such as is developed in many but not all cyprinodonts. In the young and in the female the dorsal and anal origins are on approximately the same vertical. The relations of the fins in the adult male are shown on Plate I. The fin-ray counts are indicated in Table I and fin measurements in Table II.

Gonopodium

In confirmation of the general rule that genital characters are of outstanding value as indices of both relationship and differentiation, I find that the gonopodium of *Xenodexia* (Pl. I) is definitely of the poeciliid type (p. 7) and that it has very many highly distinctive features.

The organ is rolled tightly into a narrow and very long, imperfectly enclosed tube. The tube is basically on the right side, but is twisted onto the upper left side by the rolling over of the cover, which is formed by the broad spinous segments of ray 3. In 1 of the series of immature males 21 to 23 mm. long, the anal fin shows a slight cupping on the right side.

The gonopodium is nearly 0.45 as long as the head and body. It is carried close to the ventral edge of the elongate caudal peduncle and almost reaches the lower procurrent caudal rays. It is perhaps longer proportionately than in any other poeciliid.

The very short rays 1 and 2 lie in a translucent crest along the greatly swollen base of ray 3. Segmentation has become obliterated in the basal two-fifths of rays 1 and 2 and in a basal section of ray 3 that is longer than broad. As seen from the right side, as in the enlarged figure (Pl. I, Fig. 2), the swollen base is arched downward.

At about the end of the first fourth of the length of the gonopodium, ray 3 starts the prominent upward and leftward roll that deflects the tube onto the opposite (left) side. This rolled section, which extends to within one-seventh of the length of the gonopodium from the tip, is constructed from the right side of 52 segments, of which all but the last one are much widened and are definitely spinous at the edge of the roll.

Where the main roll starts, near the base of the gonopodium, a shallow groove arises along the left side of ray 3. Along the basal part of the roll this groove becomes narrow and is twisted to the ventral edge of the intromittent organ. The right edge of the groove then becomes elevated until it forms a ridge, which, opposite the last 21 segments of the main or right-side roll, becomes rolled in the opposite direction (counterclockwise) under the ventral edge of the gonopodium to the left side. Thus, in this section, the broadly expanded and transversely curved ray 3 has 2 edges, both directed toward the left, 1 above and 1 below. The shorter, more ventral roll partly encloses a secondary tube. The rolls end near the same point, the shorter one the less abruptly. In the ventral roll there are about 20 spinous elements similar to those of the main or dorsal roll, although widely separated. The ventral roll covers the overlap of ray 3 on ray 4. The 20 spines of the lower roll are parts of the same segments that form the 20 distalmost spines of the dorsal roll. On external scrutiny it is not clear how the paired halves of ray 3 are involved in the excessive specialization of the segments in the doubly rolled section. At first consideration it would be thought that the halves merely diverge to roll in opposite directions, but to remain in contact at the front edge. At the origin of the main roll, however, it appears that the whole ray, with the halves closely joined, is involved in the formation of the roll.

Beyond the doubly rolled section, ray 3 extends to the extreme tip of the gonopodium. Here the ray is much narrower and at first is much less modified. On its outer half the terminal part bears 2 small flaps, prominent only on high magnification. The flap on the right side rises abruptly, with an obliquely truncate base and a subbasal point, but grades outward into the edge of the ray. On the opposite side of the gonopodial tip is a longer, wider, and thicker dermal process that extends almost straight outward toward the left. It rises rather abruptly opposite the second segment of ray 3 basad to the origin of the right-side flap and descends gradually to the edge of the gonopodium very close to the extreme tip.

Rays 4 and 5 are presumably branched, as in the female and young and as in the gonopodia of other poeciliids, though, except in one short section of ray 4, the complex folding and the tube structure render the identification of the branches dubious in the single mature male at hand.

From the right side ray 4 is scarcely visible at the extreme base and extreme tip of the organ and throughout most of the length is completely hidden. As seen from the left side this ray is slender opposite the thickest, basal part of ray 3. It then arches upward and broadens. As it does so the segments become strongly directed distad, so that each joint is conspicuously oblique. In this respect rays 4 and 3 contrast, for the segments of 3 are nearly transverse throughout. In this section the segments of ray 4 correspond closely in width with those of ray 3. Many abutting segments coincide, but the independence of the rays is shown by the fact that in places 2 segments of one ray lie opposite a single segment of the other ray. The segments are short and broad near the base of ray 4 but become longer and narrower outward: just proximal to the origin of the main rolled part of ray 3 the oblique segments are about one-fourth as long as wide; about two-fifths of the way out on the gonopodium the rhomboidal segments are about as long as broad. Near the middle of the length of the gonopodium ray 4 becomes hardly visible as it runs in an oblique fleshy ridge. Toward the extreme tip the ray is deflected from the left side to the bottom of the gonopodium but it extends to the extreme tip. Near the last downward bend, very close to the extreme tip, the segments of ray 4 become conspicuous again and are much broader than long; they are also much broader than the opposite segments of ray 3. Near the end of the dorsal roll of ray 3 the posterior branch of ray 4 is visible to the left and slightly below the anterior branch. Its segments are longer than wide whereas those of ray 4a in this region are wider than long. As far as I can see there is no conspicuous fusion, spination, or bilateral asymmetry of the segments of either branch of ray 4.

Ray 5 is rather slender near the base. It is even more strongly arched than ray 4 and becomes somewhat strengthened opposite the broadest and most oblique segments of that ray. Along much of the length of the gonopodium ray 5 is not readily visible. Toward the tip on the right side it seems to form the upper lip of the tube out to the extreme tip of the gonopodium.

Rays 6 and 7 are moderately curved, and considerably thickened, with subquadrate segments, where they form the roof of the basal part of the tube. A fleshy process from the posterior edge of ray 3 nearly closes the extreme base of the tube. The membranes about rays 6 and 7 are also much thickened and ray 6 extends into a pointed lobe. Along the front edge of the basal part of ray 6 the segments flare apart. The following rays

are much slenderer and the last ones are so short and delicate as to be countable only with extreme care.

Specialized scales, somewhat thicker and stronger than usual, form a sheath, with a definite edge, over the extreme base of the gonopodium, on the right side only. The anterior base of the gonopodium is embraced by a parabolic membrane, much as the anal fin in the female of *Fundulus* is surrounded by the oviducal pouch.

Gonopodial Suspensorium

As noted earlier (p. 7), and as seen in X-ray photographs, two of which are reproduced (Pl. IV, Figs. 1-2), the gonopodial suspensorium of *Xenodexia ctenolepis* is of the poeciliid type. The suspensorium is connected with the vertebrae that are transitional between the precaudal and caudal types (p. 14). Vertebra 13 is definitely precaudal and scarcely modified.

The 4 strong gonapophyses (specialized hemal spines supporting the interhemals) are attached to vertebrae 14 to 17. They are about one-third as long as the body is deep. All are flattened toward the tip and all are angled forward. The basal halves form angles with the vertebral column of about 86, 79, 95, and 110 degrees. The angles formed by the axes of the 2 limbs of each gonapophysis are about 62, 75, 85, and 76 degrees. The especially broad distal part of the second one is a sharp triangle of about 22 degrees. The most ventral parts of the gonapophyses are on a line that slopes downward at an angle of 23 degrees with the posterior vertebrae of the caudal peduncle. There are, apparently, no definite uncinatoid processes. Parapophyses seem to be scarcely developed on vertebra 14 (the first with a gonapophysis), for the ribs appear to be sessile, but on the 6 following vertebrae, parapophyses are apparently developed. They seem to be moderately strong though short on vertebrae 17 (the last with a gonapophysis) and 18, but weaker on the vertebrae on either side. Ribs are developed at least as far as the sixteenth vertebra; possibly, to a weak degree, on 1 or 2 more.

The first gonapophysis seems to contact the upper posterior corner of the compound interhemal. The second and third support the posterior interhemals. The fourth probably has only a ligamentary connection with the interspinous bones. The anterior tip of the third apparently contacts the lower posterior angle of the second.

The compound interhemal is obviously a strong, rather well consolidated rod or plate. Its dimensions, determined from an X-ray photograph (Pl. IV, Fig. 1) and expressed as thousandths of the the standard length, are: greatest length, 112; greatest anteroposterior width, near top, 50; least anteroposterior width, 22; greatest width near ventral edge, 39; least dis-

tance from vertebral column, 47. The constituent interhemals are not certainly identifiable. The first is probably very short, since it is so in other poeciliids. The clearer X-ray photograph shows at least 3 rods, of which the median is slender and the others broad and rounded at the upper edge. Following the compound structure is a slender interhemal that dorsally seems to touch the main structure, as well as the tips of the first 2 gonapophyses, but ventrally diverges slightly from the compound interhemal, as well as from the next of the several following, obliquely set, narrow interhemals.

Pectoral Clasper

As previously noted (p. 5), though the left pectoral is essentially unmodified, the right fin and surrounding structures are marvelously specialized (Pl. II, Figs. 2-3). Behind this fin is a voluminous pocket, in the 40 mm. fish fully 5 mm. high, 2 mm. across when the fin base is extended outward, and 3 mm. deep, not including the fin itself. The muscle mass on the breast at the base of the right pectoral seems to be twice as thick and twice as expansive in area as the corresponding muscle mass on the left side. Along the base of the right fin is a hard sheath made of very thick scales (pp. 15-16). This sheath forms a pocket at the base of the fin and is extended as a rounded lobe for a full millimeter (more than 2 per cent of the standard length of the fish) below and beyond the lower end of the fin.

The fin rays, however, are only slightly specialized. The uppermost ray is a little enlarged and instead of forming a splint at the base of the next ray is well separated from it. This second ray is a little more arched than usual and is considerably thickened. Instead of being branched, as it is in the adult female, the third ray remains simple.

The clasper-like structures are outgrowths from the upper part of the fin base. How much modified the skeleton of the pectoral girdle may be is not fully clear from the X-ray pictures, and dissection of the holotype (the only known adult male) seems unwise.

The clasper proper comprises an assortment of hooks, pads, and other processes (Pl. II, Figs. 2-3). One of the most conspicuous is a long, complexly curved structure labeled *a*. Its main axis is supported by a bone-hard, translucent rod, which arises, opposite the upper base of the fin, from the upper part of a large soft pad (*b*). The rod extends backward and slightly upward, then curves abruptly upward and finally mesad. Near its first bend it supports a fleshy keel (*c*). On the posterior edge of its tip it gives off 2 small processes partly enclosing a semicircular recess. On the inside, opposite the uppermost ray, process *a* is connected with the outer face of the fin by a thin membrane (*d*). From the point where the edge of the membrane is attached to process *a*, there extends downward a fleshy, flask-shaped structure, first as a pointed tip in the membrane and

then as a bulbous expansion (*e*) on the base of the fin. Five processes (*f-j*) of varied size, shape, and hardness arise from the upper edge of the fin near its base. On the upper part of the shoulder girdle is a much larger bilobed fleshy structure (*k*). The lower lobe is closely bound to the base of process *a* and the upper lobe is loosely connected by a membrane with lobe *f*.

It seems obvious that this complex organ is a clasper. Exactly how it functions can only be surmised. The large deep pocket behind the structure and the known clasping habits of other fishes lead one at first to suspect that the male approaches the female from the one side and clasps her with the modified pectoral. A surprising yet more plausible theory as to the function of the clasper has been suggested by Reeve M. Bailey. He has pointed out that if the gonopodium is deflected forward it will be caught and held in position by process *a* so as to leave the functional tip just exposed over the outer part of the large pocket. When an adult female is inserted into the pocket so that the modified pectoral fin of the male clamps down on the anal fin of the female, it is seen that the tip of the gonopodium comes into contact with the genital opening of the female, which seems to be modified so as to receive the gonopodial tip when the two fish are in this position.

Sex Organs of Female

The genital papilla of the one fully mature female at hand is very interestingly modified (Pl. II, Fig. 1). As seen from the left side the papilla is a subconical structure about 1 mm. long (2.5 per cent of the standard length). It has a bifurcate tip, of which the anterior process is the longer and the slenderer. From the right side it may be seen that these two tips are the ends of the fleshy rims of a largely open tube, which curves outward toward the right near the middle of the papilla and then inward into the oviduct between the expanded and approximated bases of the two rims.

The mode of formation of this complex genital opening is indicated by the maturing female, in which the two tips arise almost side by side from the fleshy region between the anus and the anal fin. Already the tip of the right side is somewhat the more anterior. Behind the two tips a groove extends backward and toward the left. The groove, however, faces both backward and toward the right. A slight twisting of the papilla as it develops obviously suffices to shift the groove into the lateral position seen in the adult female.

The ovary, which has a definite oviduct, is slightly diverted to the left side. The embryos are separated, each in its own pocket, by thin transparent membranes. In the young female the gonad is slender, but contrasts with the immature testis in having smooth walls rather than a crenate border, in being cylindrical instead of flattened, in being more translucent, in having a definite stalk (the oviduct), and in not showing a line of fusion

of the left and right organs. Furthermore, under high magnification, the ova can be distinguished from the tubules of the testis.

SUPERFETATION AND DEVELOPMENT OF PIGMENTATION

Since the mature female contains embryos in various stages of development, *Xenodexia* is added to the list of poeciliids in which development involves superfetation (Turner, 1937, 1940; Scrimshaw, 1944). In its ovary, 5×9 mm. in major dimensions, with major irregularities due to the protuberances about embryos, there is one maturing or mature egg 1.31×1.64 mm. in major diameters and 6 embryos in 5 stages of development: (1) The smallest embryo, about 3.0 mm. long, retains a yolk sac more than 0.5 mm. in diameter. It is unpigmented except in the eyes. (2) Two embryos, each about 6.0 mm. long, have considerable pigment on the top of the head, 2 rows of melanophores along the middorsal line, 1 row along the axial septum, and 2 rows along the lower edge of the caudal peduncle and the base of the anal fin. (3) One embryo, 8.3 mm. long, is considerably more advanced in development and has the head and the middle of the trunk well pigmented. (4) One embryo, 9.7 mm. long, shows further advances in development, but is obviously not yet ready for birth. Melanophore pigment is developing along the edges of the scale pockets near the back. (5) One embryo, 10.5 mm. long, seems to be about ready for birth. The pigmentation is now well developed around the scale pockets and the fish looks much like the juveniles about 20 mm. long. The advanced embryos, however, differ in several respects from the young at that size (p. 17).

Superfetation is especially characteristic of the subfamily Poeciliopsinae, which the genus *Xenodexia* resembles in gonopodial structure and some other respects (p. 9).

SEX RATIO

The 40 known specimens comprise 33 females and only 7 males. To insure accuracy in sex identification all specimens except the adult male were opened to inspect the gonad. For the maturing and mature fish the ratio was 2 females to 1 male. Of much greater significance in estimating the sex ratio is the observation that the immature fish comprised 31 females and only 6 males. Since most of these fish showed almost no enlargement of the gonad, differential schooling is highly improbable and differential mortality seems unlikely. The disparity in the ratio 31 to 6 is trustworthy, for the χ^2 value is 16.9 and the probability value 3.7×10^{-5} . It is probable, therefore, that females of *Xenodexia* markedly outnumber the males, even in the young fish. The disturbed sex ratio may be correlated with the perfection of the inseminating mechanism.

SEXUAL DIMORPHISM IN SIZE AND FORM

Despite the aberrant sex ratio and the strong sexual dimorphism in other respects, the sexes of *Xenodexia*, unlike those of the Poeciliopsinae and many other poeciliids, are probably similar in size. The 1 adult male now measures 40.1 mm. in standard length; the maturing female, 39.1 mm. and the mature female, 40.5 mm. The 6 juvenile males are 21 to 23 mm. long; 24 of the 31 immature females are 19 to 25 mm. long. The 7 larger immature females measure 28 to 34 mm.

In form and structure the sexual dimorphism is very notable. The secondary sexual modification of the anal fin and associated structures is rather extreme (Pls. I, IV; pp. 18-22). There are considerable differences in the general form of the body and head (pp. 11-12). The comparative measurements (Table II) indicate that the adult male differs from the female and young in many ways: The body is deeper than in any except pregnant females. The caudal peduncle is markedly deeper. The dorsal and pelvic fins are considerably advanced in position; the anal fin, very markedly so. The head is shorter, narrower, and slenderer, in proportion to the standard length, though not in relation to the head length. The snout is much shorter, only about one-fourth rather than one-third the head length, and 54 rather than 72 to 77 thousandths of the standard length. The eye is a little larger relative to the head length. The inter-orbital and the mouth are narrower, in reference to head length as well as body size. The dorsal base is longer and the pectoral fin may be longer. The sexual dimorphism is of the poeciliid type.

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In the preparation of this paper I have received much help from several colleagues, mostly staff members of the University of Michigan. First, I wish to thank Laurence C. Stuart for the time and effort he spent in collecting fishes in many out-of-the-way parts of Guatemala. My successor in the Museum of Zoology, Reeve M. Bailey, has given every possible co-operation in my studies, both in Ann Arbor and in La Jolla, and has made a very helpful suggestion as to the function of the pectoral clasper. Laura C. Hubbs assisted in statistical calculations and in other ways. William A. Gosline kindly took the needed X-ray photographs. William Cristanelli of the Institute for Fisheries Research, Michigan Department of Conservation, took the photograph of the ctenoid scale. It is a particular pleasure to acknowledge with appreciation Grace Eager's initial work on the drawings, which were left unfinished by her untimely death. Alma W. Froderstrom has completed them.

SUMMARY

Xenodexia ctenolepis, a new genus and species from an area of endemism in the upper part of the Río Usumacinta system in Guatemala, is so highly specialized as to call for its segregation in a distinct subfamily, Xenodexiinae. Its most distinctive features are an elaborate unilateral pectoral-fin clasper of the adult male—a structure unique among fishes; ctenoid scales, hitherto unknown and unpredicted in the order Cyprinodontes; and an extreme extension of the body cavity into the urosome. A large variety of characters, including genital and genitalial structures of high taxonomic value and 2 recently discovered features that are independent of sex, indicate that this bizarre fish should be classed in the family Poeciliidae, but alternative possibilities are not wholly eliminated. *Xenodexia* may have been derived from the Poeciliopsinae, but the very complex tubular form of the gonopodium may have been evolved independently. In *Xenodexia* this structure (the intromittent organ) is extremely long and very complex.

It seems probable that the ctenii on the scales of *Xenodexia* represent reversible evolution, but probably only in the sense that the ctenii were long lost in phenotypic expression, not in genetic potential. The discovery of ctenoid scales in a member of the order adds weight to the view that the Cyprinodontes were derived from an ancestor, possibly an acanthopterygian, well advanced along the teleost line of evolution.

Insemination in *Xenodexia* is presumably effected when the male holds the female in the recess behind the highly modified base of his right pectoral fin, the upper part of which is replete with hard and fleshy hooks and pads. The forward-turned gonopodium is probably held securely in place by the main hook of the clasper. In this position its fleshy tubular tip would fit into the clasped female's genital papilla, which is grooved on the right side, to complete what seems to be a lock-and-key mechanism. Perhaps in correlation with the perfection of the inseminating mechanism, the males seem to be greatly outnumbered by the females. The sexes appear to attain about the same size, but sexual dimorphism in form and structure is rather extreme. *Xenodexia ctenolepis* is one of the poeciliids, the development of which involves superfetation. As many as 5 broods in different stages of development are present at one time in the ovary.

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PLATE I

FIG. 1. *Xenodexia ctenolepis*, holotype, mature male, from left side. The dorsal, pectoral, and pelvic fins, damaged in the holotype, were reconstructed from female paratypes.

FIG. 2. Gonopodium of holotype of *Xenodexia ctenolepis*, from right side. Drawings begun by Grace Eager, completed by Alma W. Froderstrom.

PLATE I

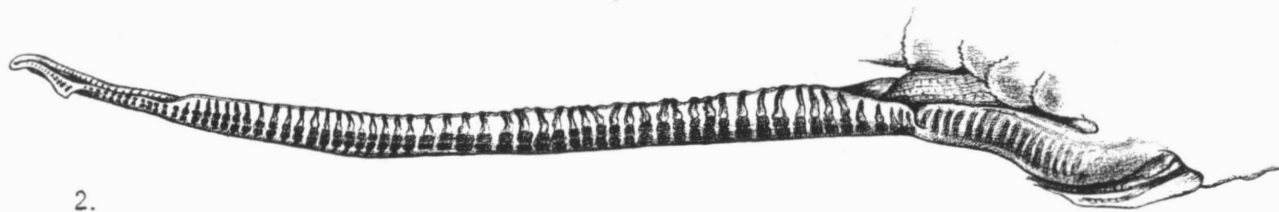
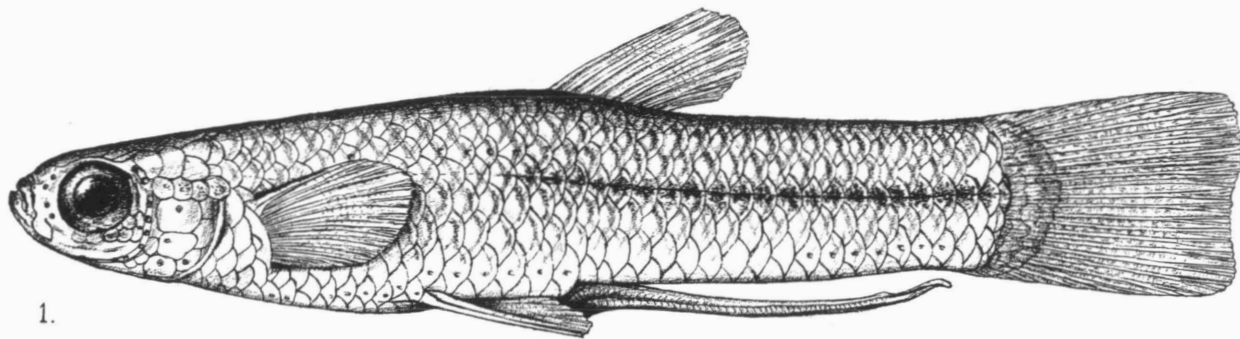
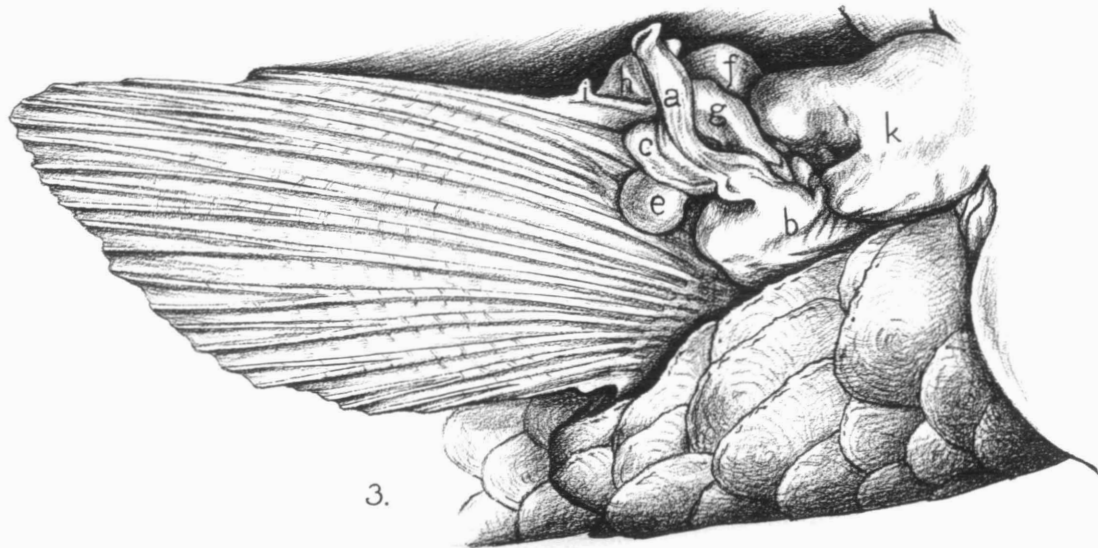
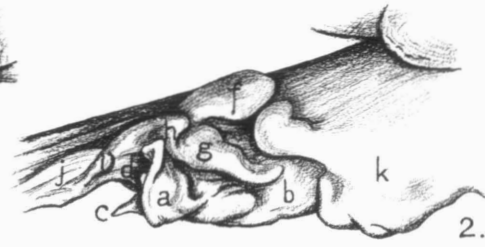
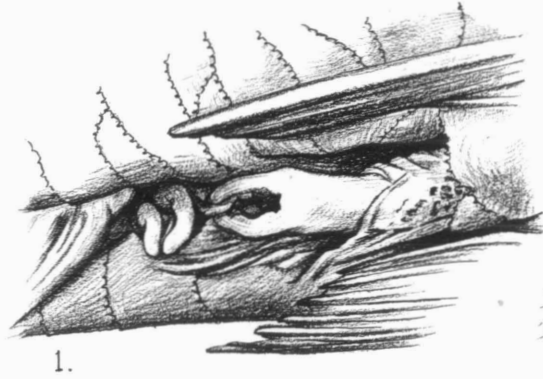


PLATE II



NEW SUBFAMILY FROM GUATEMALA

PLATE II

Copulatory structures of *Xenodexia ctenolepis*.

FIG. 1. Genital papilla of mature female paratype (41 mm. long), from right side.

FIG. 2. Dorsal view of pectoral clasper of holotype. For explanation see text (pp. 22-23).

FIG. 3. Lateral view of the same structure. The left pectoral fin is unmodified.

Drawings begun by Grace Eager, completed by Alma W. Froderstrom.

CARL L. HUBBS

PLATE III

Scale from the axial series of adult female (41 mm. long) of *Xenodexia ctenolepis*, showing the ctenii and a neuromast or pit organ.

PLATE III

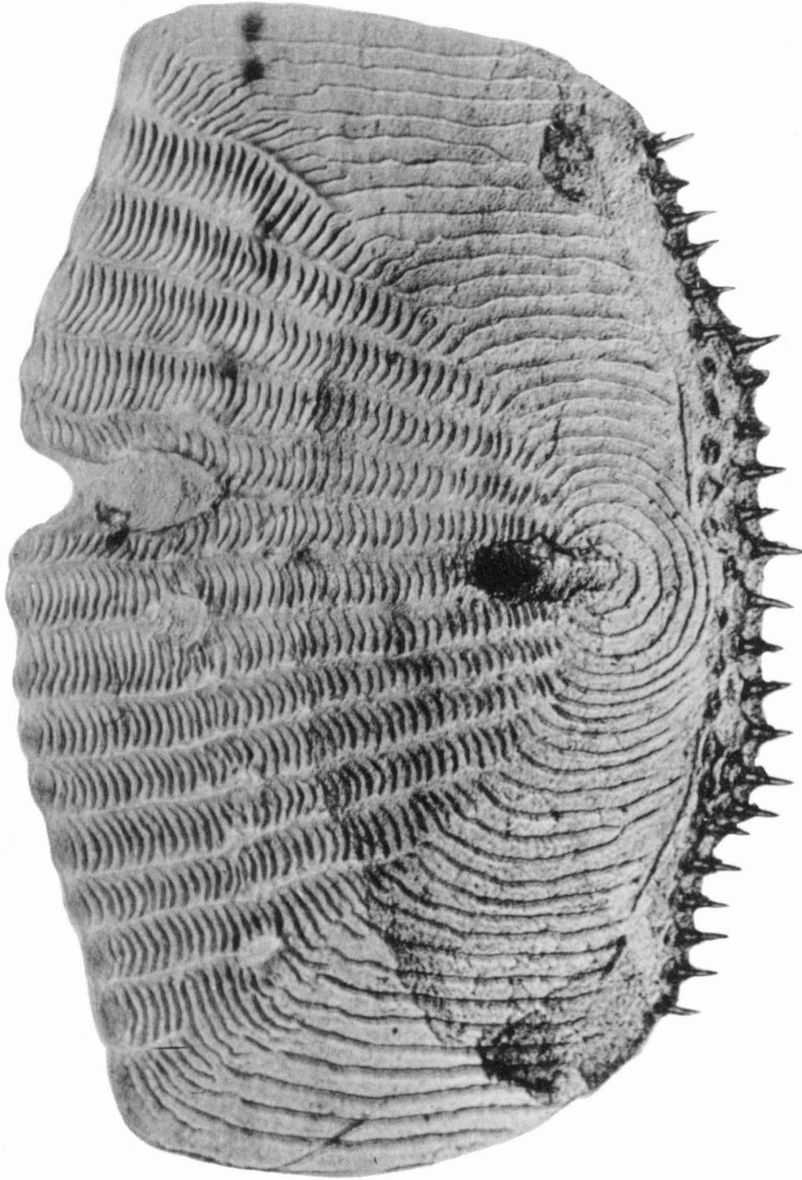


PLATE IV

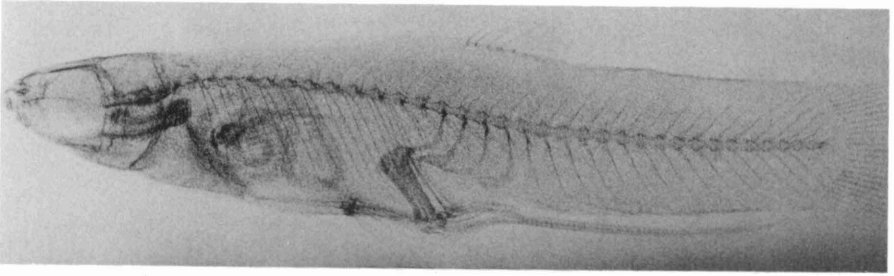


FIG. 1

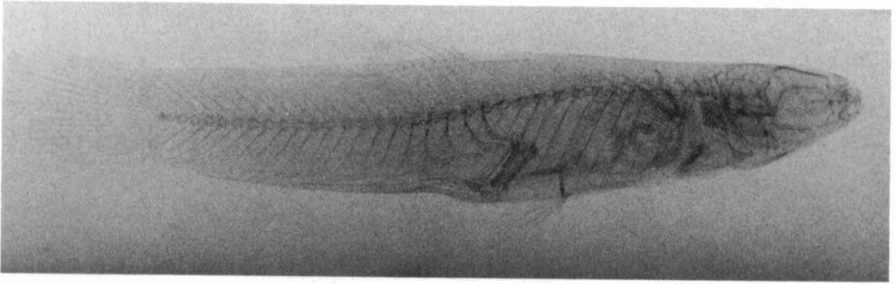


FIG. 2

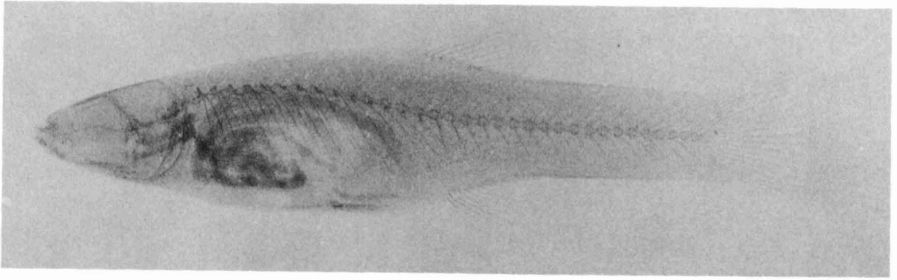


FIG. 3

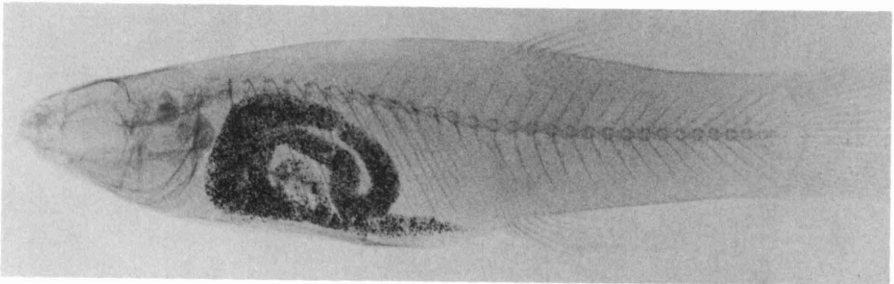


FIG. 4

NEW SUBFAMILY FROM GUATEMALA

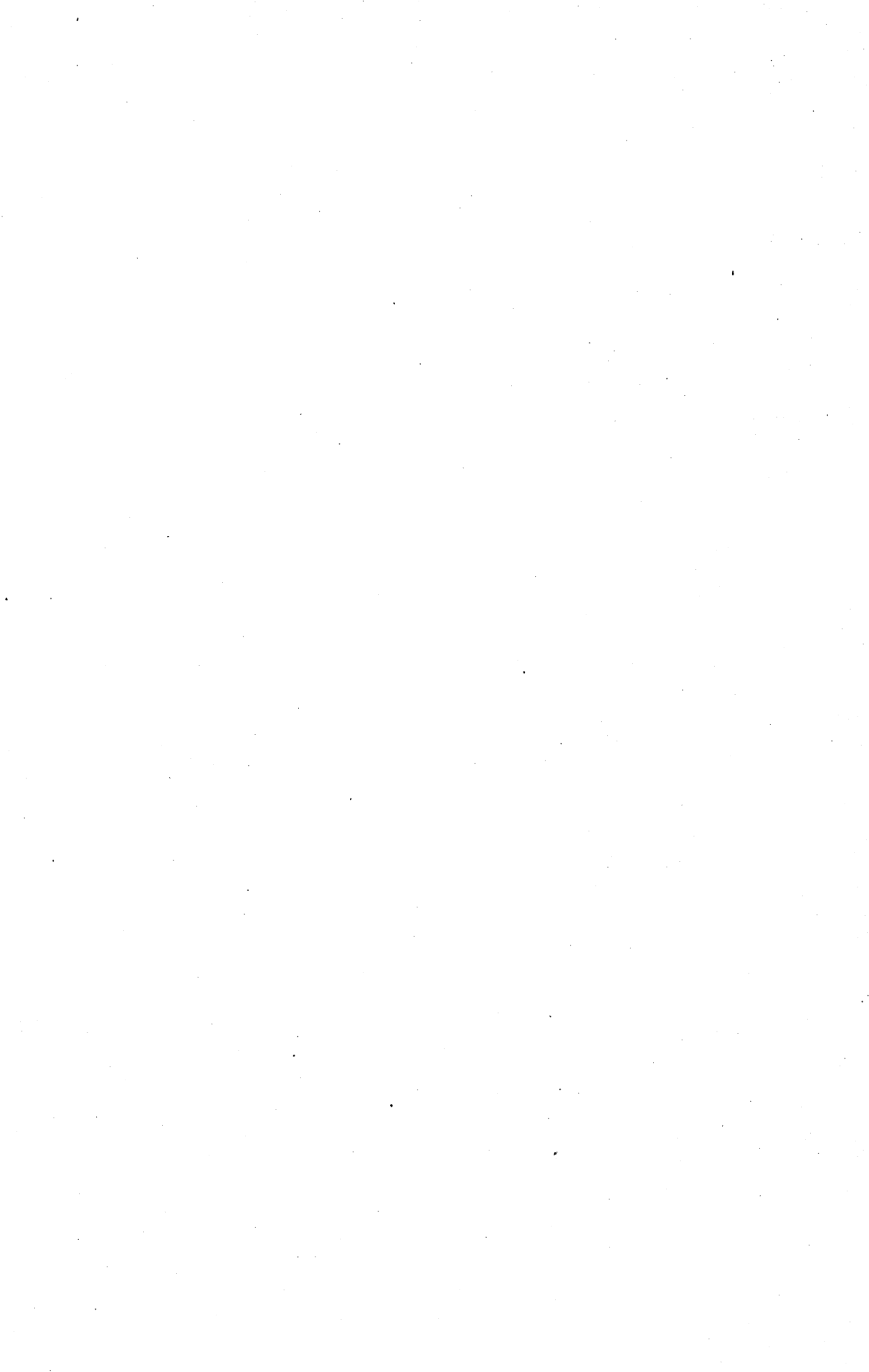
PLATE IV

X-ray photographs of *Xenodexia* and *Poecilistes*.

FIGS. 1-2. Holotype of *Xenodexia ctenolepis*, a mature male, 40 mm. long.

FIG. 3. Maturing female paratype of *Xenodexia ctenolepis*, 39 mm. long.

FIG. 4. Adult female of *Poecilistes pleurospilus pleurospilus* (Günther), 41 mm. long, collected by Carl L. Hubbs and Henry van der Schalie on February 5, 1935, in Río Michatoya near Palín, Depto. Amatitlán, Guatemala.



(Continued from inside front cover)

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