

NUMBER 60

JUNE 27, 1918

OCCASIONAL PAPERS OF THE MUSEUM OF
ZOOLOGY

UNIVERSITY OF MICHIGAN

ANN ARBOR, MICHIGAN

PUBLISHED BY THE UNIVERSITY

A REVIEW OF THE FISHES DESCRIBED IN COPE'S
PARTIAL CATALOGUE OF THE COLD-BLOODED
VERTEBRATA OF MICHIGAN

BY HENRY W. FOWLER

In 1864 Professor E. D. Cope published the first part of his article included under the above title,¹ and the second part was concluded in the following year.² Since Agassiz's account of the fishes in his work on Lake Superior, little was known of the Michigan fauna until Cope's work appeared. Though treating mainly of Michigan, various new forms from elsewhere in the United States are described in foot-notes, and the work is thus expanded to a wider scope. The Michigan material was obtained from the Flint Scientific Institute, the State Agricultural College and the State Collection through Prof. Manly Miles. While many of the specimens were ob-

¹ Proc. Acad. Nat. Sci. Philad., 1864, pp. 276-285.

² L. c., 1865, pp. 78-88.

tained for the collection of the Academy of Natural Sciences of Philadelphia years ago, some others were more recently received with Cope's collections shortly after his death.

In 1917 Dr. Alexander G. Ruthven suggested that I study over our Michigan material and furnish him a report, as it would be desiderata in connection with the local ichthyological explorations now being carried on. Accordingly I searched our collections and have been able to present details concerning types or specimens of sufficient importance. The entire list of Cope's fishes is the basis of this paper, and such references as pertain to his materials are included. In cases where his species are no longer represented by specimens no comment is made. A small collection made about 1901 at Pequaming, Lake Superior, in Baraga County, by Mr. Morgan Hebard, is also included.

PETROMYZONIDÆ

Ichthyomyzon concolor (Kirtland)

Ichthyomyzon argentatus Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 276.

Entosphenus apypterus (Abbott)

Lampetra apyptera Fowler, Proc. Acad. Nat. Sci. Phila., 1907, p. 465. Grosse Isle and Ann Arbor.

Two examples in poor preservation, both received from Cope, and the Grosse Isle one, a nearly metamorphosed larva, obtained by Prof. Charles Fox. They agree with other material from New Jersey, Pennsylvania and Iowa.

Two small lampreys without data and belonging to the preceding species may have come from Michigan. Mr. H. Cummins informs me that the example I recorded in 1907 as the present species is also the preceding species.

LEPISOSTEIDÆ

Lepisosteus osseus (Linnæus)

Lepisosteus huronensis Cope, l. c., p. 276. Saginaw Bay.

Possibly some of the examples without data I recorded in 1910 as *L. huronensis* may be Cope's Saginaw Bay material.

Cylindrosteus platostomus (Rafinesque)

Lepisosteus (Cylindrosteus) oculatus Winchell, Proc. Acad. Nat. Sci. Phila., 1864, p. 183. Duck Lake, Calhoun County, Michigan.

Lepisosteus oculatus, Cope, l. c. (on type).

AMIATIDÆ

Amiatus calva (Linnæus)

Amia calva, Cope, l. c.

A number of examples without data doubtless in part refer to Michigan examples.

SALMONIDÆ

Cristivomer namaycush (Walbaum)

Trutta namaycush Cope, l. c., 1865, p. 80. Saginaw Bay.

An undetermined species of *Coregonus* is also listed by Cope, but no examples are in the Academy.

THYMALLIDÆ

Thymallus tricolor Cope

Thymallus tricolor Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 80. Michigan.

Thymallus tricolor Fowler, Proc. Acad. Nat. Sci. Phila., 1911, p. 555 (type). Au Sable River and Michigan.

Head 4 1/2; depth 4 3/5; D. VIII, 14; A. IV, 9, 1; P. I, 15; V. I, 9; scales in lateral line 80 to caudal base and 3 more on

latter; 10 scales above 1. 1., 8 below; 31 predorsal scales; head width $2 \frac{2}{5}$ its length; head depth at occiput $1 \frac{4}{7}$; snout $3 \frac{3}{4}$; eye $3 \frac{3}{4}$; maxillary $2 \frac{1}{2}$; interorbital $3 \frac{4}{5}$; mandible 2; first branched dorsal ray $1 \frac{3}{4}$; first branched anal ray 2; least depth of caudal peduncle $2 \frac{3}{4}$; pectoral fin $1 \frac{4}{7}$; ventral $1 \frac{3}{4}$; lower caudal lobe about $1 \frac{1}{6}$.

Body elongated, compressed, profiles similarly convex, apparently deepest at ventral origins and edges convex. Caudal peduncle compressed, least depth about $1 \frac{3}{4}$ its length.

Head compressed, profiles similar, flattened sides not converging above or below. Snout slightly convex over surface, its profile a trifle convex and basal width about $1 \frac{1}{4}$ its length. Eye a little ellipsoid, high or close to upper profile, at first $\frac{2}{5}$ in head. Mouth moderate, gape short and horizontal. Maxillary well inclined, reaches back opposite front pupil edge, its greatest distal expansion $2 \frac{2}{3}$ in eye. Teeth in jaws small, conic, of about uniform size, curved inward, series separated in front of jaws and all more or less concealed within thickened lips. Series of about 6 teeth in each premaxillary edge inside in front. Also a series similarly along each anterior maxillary edge. Small patch of small teeth on front of vomer and each palatine roughened with similar teeth, these most developed anteriorly on bones. Tongue smooth, depressed, edge free in front and along sides, rather broad front rounded. Mandible shallow in front, rami well elevated inside mouth anteriorly and equal with snout tip in front. Front of each jaw entire, mouth transversely horizontal as viewed from before. Nostrils about midway in snout. Interorbital broadly depressed. Upper maxillary edge slips below narrow, straight and oblique preorbital edge. Postorbital width half

of eye diameter. Hind preopercle edge evenly convex, free. Opercle width $1 \frac{1}{5}$ its depth.

Gill-opening extends forward opposite front pupil edge. Rakers $6 + 13$, lanceolate, 3 in eye. Filaments $1 \frac{3}{5}$ in eye. Pseudobranchiæ about a third of eye. Isthmus narrowly constricted. Branchiostegals $10 + 10$, upper little larger.

Scales rather small, disposed in even longitudinal series parallel with lateral line, mostly of about uniform size, cycloid and each scale well exposed. Preventral and front predorsal regions finely scaled though breast anteriorly naked. Ventral with scaly axillary flap. L. 1. complete, about midway along side and each scale with a simple tube extending about first half over each exposure.

Dorsal origin about first third in space between snout tip and caudal base, graduated up to first branched or longest ray, other branched rays but slightly shorter. Adipose fin origin about midway between depressed dorsal tip and caudal base, fin 4 to caudal base. Caudal forked, lobes pointed, about equal. Anal origin a little nearer last branched dorsal ray than caudal base, first branched ray longest and falling a little short of last when depressed, fin $1 \frac{2}{3}$ to caudal base. Upper pectoral rays longest, fin about half way to ventral. Latter inserted about opposite middle of dorsal base, fin half way to anal origin. Vent?

Color in alcohol faded, largely dull or pale brownish, silvered or whitish below. Fins all pale brownish and all medianly and terminally with somewhat dusky shades. Iris brownish.

Length about 179 mm.?

No. 7,796, A. N. S. P., type of *Thymallus tricolor* Cope. Au Sable River, Michigan. E. D. Cope. This example in very poor preservation several years ago, when the above description was made.

Another from the same locality (Smithsonian Inst. No. 11,088) also in poor preservation. Head about $4 \frac{3}{5}$; depth about $4 \frac{3}{5}$; D. VIII, 14; A. IV, 9; scales in l. l. 80 to caudal base and 5 more in latter; 9? scales above l. l., 8 below; 28 predorsal scales; length about 242 mm.

Head $5 \frac{1}{6}$; depth $4 \frac{2}{5}$; D. VIII, 14; A. V, 10, 1; scales 86 in l. l. to caudal base and 5 more in latter; 9 scales above l. l., 9 below; 25 predorsal scales; snout 4 in head measured from upper jaw tip; eye 4; maxillary $2 \frac{3}{5}$; interorbital $4 \frac{1}{8}$; last dorsal ray $1 \frac{2}{5}$; pectoral $1 \frac{2}{5}$; ventral $1 \frac{2}{5}$; least depth of caudal peduncle $2 \frac{2}{5}$; length 318 mm. Dried skin from Michigan (J. A. Shultz). It shows a few small dusky spots at the front costal region, all well separated.

ICTALURIDÆ

Ictalurus punctatus (Rafinesque)

Ictalurus gracilis Cope, l. c., 1864, p. 276.

Ameiurus natalis (Le Sueur)

Ameiurus natalis Fowler, l. c., 1915, p. 207. Oakland County.

Ameurus cupreus Cope, l. c., (same material).

One example in the collection.

Ameiurus vulgaris (Thompson)

PLATE I

Head $3 \frac{1}{3}$; depth 4; D. I, 5, 1; A. VI, 14, 1; snout $2 \frac{4}{5}$ in head measured from upper jaw tip; eye 9; maxillary 3; interorbital $2 \frac{1}{8}$.

Body long, well compressed, deepest at dorsal origin. Head well depressed, much wider than deep. Snout broadly de-

pressed and its length about $\frac{3}{5}$ its width at front of eye. Eye small, largely lateral, ellipsoid, and hind edge well before center in head length. Mouth broad, lower jaw well protruding in front. Teeth fine, in villiform bands in jaws. Maxillary barbel reaches pectoral origin, nasal barbel $2\frac{1}{2}$ times eye length, outer mental barbel $1\frac{3}{4}$ to pectoral origin and inner $2\frac{1}{2}$ in same space. Upper surface of head and interorbital rather convexly elevated. Space unossified between end of occipital process and front of dorsal plate slightly greater than horizontal eye-diameter. Gill-rakers $5 + 8$, short points, longest about $\frac{3}{4}$ of eye. Humeral process finely and rather obsoletely rugose. Skin smooth. Dorsal inserted midway between tip of lower jaw and first fourth in adipose fin length, and depressed fin about half way to adipose fin. Dorsal spine slender, edges smooth, about as long as snout. Adipose fin very slightly shorter than dorsal spine. Anal inserted a little nearer caudal base than pectoral origin. Caudal truncate. Pectoral reaches $1\frac{3}{4}$ to ventral, spine short, smooth and but a trifle longer than snout. Ventral inserted about midway between caudal base and snout tip, fin reaches anal.

Color in alcohol largely uniform brownish, belly and under surface of head faded whitish. Iris grayish. Barbels all more or less brownish. Fins also brownish.

Length 272 mm.

Only one example, obtained April, 1859, in Saginaw Bay, E. D. Cope.

Noturus flavus Rafinesque

Noturus flavus Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 277. Swartz Creek in Genesee County.

Noturus flavus Fowler, Proc. Acad. Nat. Sci. Phila., 1915, p. 208 (above material).

Two examples now in the collection with above data.

CATOSTOMIDÆ

Carpiodes thompsoni Agassiz

Carpiodes thompsoni Cope, l. c., p. 285. Saginaw Bay.

Carpiodes thompsoni Fowler, l. c., 1913, p. 46 (above material).

Carpiodes thompsonii Cope, Proc. Amer. Philos. Soc., XI, 1870, p. 483 (above material).

One Saginaw Bay example in the collection.

Carpiodes selene Cope

PLATE 2

Carpiodes selene Cope, l. c., pp. 479-481. Probably *Root River, Michigan*.

Carpiodes selene Fowler, l. c., p. 47 (types?).

Head 4; depth $2 \frac{1}{3}$; D. v, 21, 1; A. iv, 7; P. i, 14; V. i, 8; scales 33 in lateral line to caudal base and 4 more on latter; 8 scales above 1. l., and 5 below to ventral origin (6 to anal origin); 15 predorsal scales; head width $1 \frac{3}{4}$ its length; head depth at occiput $1 \frac{1}{8}$; snout $3 \frac{1}{3}$; eye 4; mouth width $4 \frac{2}{5}$; snout tip to hind maxillary end $3 \frac{3}{4}$; interorbital $2 \frac{1}{6}$; fourth simple dorsal ray $1 \frac{2}{3}$; fourth simple anal ray $1 \frac{1}{6}$; pectoral $1 \frac{2}{7}$; ventral $1 \frac{1}{10}$; least depth of caudal peduncle $1 \frac{2}{3}$.

Body deep, compressed, back elevated, so that predorsal well convex but after dorsal origin sloping gradually down. Predorsal edge constricted, not sharply trenchant, and other edges all rounded convexly. Lower profile but slightly convex, much less so than upper. Greatest depth at dorsal origin. Caudal peduncle well compressed, length about $\frac{3}{4}$ its least depth.

Head moderately small, broad, sides slightly convex, but very slightly convergent below, and upper profile much more inclined than lower. Snout very obtuse, with slight anterior

depression, its front profile nearly evenly semicircular, surface generally convex, and length from middle of front snout extremity to eye about $\frac{3}{5}$ its width. Eye a little ellipsoid, rather high, and center falls about first third in head. Mouth small, transversely crescentic, opens down and forward. Maxillary small, reaches back trifle beyond front pupil edge though not quite to eye center. Lips rather thick and fleshy, moderately broad, with small papillæ and obsolete plications. Jaw edges obtuse, broad. Mandible shallow in front, rami well elevated inside mouth. Tongue adnate, thick, fleshy, depressed. Nostrils together, close before and about opposite eye center, anterior large pore and posterior larger and with slight cutaneous flap in front. Interorbital broad, rather unevenly convex, depressed in front. Cranial bones somewhat cavernous. First suborbital nearly of equilateral triangular form, length $1 \frac{1}{4}$ in eye. Second suborbital much smaller and narrower, and third equally narrow, though its length nearly equals eye. Last also with very obsolete striæ. Opercle and subopercle strongly striate, former with width about half its length.

Gill-opening forward about last fourth in head length. Gill-rakers about $30 + 17$, slender, $1 \frac{4}{5}$ in eye. Filaments $1 \frac{1}{2}$ in eye. Pseudobranchiæ obsolete, less than filaments. Branchiostegals 3, robust, median a little more enlarged or bulky than others. Isthmus width $1 \frac{1}{10}$ in eye.

Scales large, moderately imbricated, of mostly uniform size, disposed in series parallel with l. l., and each with many radiating striæ. Scales on breast but little smaller than others, though those along bases of dorsal and anal smallest. Scales on base of caudal rather small. Axillary ventral scaly flap scarcely developed. L. l. complete, median along side, inclined little below middle of caudal peduncle side. Tubes simple, extend horizontally to hind scale edges. No tubercles.

Dorsal origin nearer snout tip than caudal base, fifth simple ray longest, prolonged back far as tips of median caudal rays. Simple dorsal rays not especially osseous. Anal inserted little nearer ventral base than caudal base, fourth simple and first branched rays subequally longest, and fin depresses back slightly beyond caudal base. Caudal well forked, upper lobe longer or $2 \frac{1}{3}$ in head and trunk, both lobes sharply pointed. Pectoral broad, slightly over half way to ventral. Ventral origin about opposite second branched dorsal ray base, fin reaches vent close before anal.

Color in alcohol dull or uniform brassy-brown. Iris brownish.

Length 293 mm.

No. 6,647, A. N. S. P., cotype (type) of *Carpiodes selene* Cope. Probably Root River, Michigan. E. D. Cope.

Another cotype, No. 6,648, A. N. S. P., same data, shows: head 4; depth $2 \frac{2}{7}$; D. v, 25, 1; A. 1v, 7, 1; scales 33 in lateral line to caudal base and 4 more on latter; 8 scales above 1. l., 6 below to anal origin; 16 predorsal scales; snout $4 \frac{1}{5}$ in head; eye $3 \frac{5}{6}$; mouth width 4; interorbital $2 \frac{1}{3}$; length 236 mm.

Catostomus nigricans Le Sueur

Hylomyzon nigricans Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 285. Grosse Isle.

Moxostoma aureolum (Le Sueur)

Ptychostomus aureolus Cope, l. c., p. 285. Saginaw Bay and Grosse Isle.

Ptychostomus aurcolus Cope, Proc. Amer. Philos. Soc. Phila., XI, 1870, p. 476. Saginaw Bay.

Moxostoma aureolum Fowler, Proc. Acad. Nat. Sci. Phila., 1913, p. 59 (Saginaw Bay example).

One from Saginaw Bay in the Cope collection.

CYPRINIDÆ

Campostoma anomalum (Rafinesque)

PLATES 3 AND 4

Campostoma callipteryx Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 284. Flint on the Flint River, which empties into Saginaw Bay.

Campostoma mormyrus Cope, l. c., p. 284. Bruce, Macomb County.

Campostoma gobioninum Cope, l. c., p. 284. Bruce, Macomb County, and Grosse Isle.

Head 4; depth $3 \frac{1}{8}$; D. III, 7, 1; A. III, 6, 1; scales 46 in lateral line to caudal base and 3 more on latter; 8 scales above l. l., and 7 below; snout $2 \frac{4}{5}$ in head; eye $4 \frac{1}{2}$; maxillary $3 \frac{7}{8}$; interorbital $2 \frac{9}{10}$; first branched dorsal ray $1 \frac{1}{3}$; anal ray $1 \frac{1}{2}$; least depth of caudal peduncle $2 \frac{1}{8}$; pectoral $1 \frac{1}{4}$; ventral $1 \frac{3}{7}$; teeth 4 - 4. Body well compressed, upper profile more evenly convex than lower, deepest at dorsal origin, edges rounded. Caudal peduncle compressed, least depth about $1 \frac{5}{7}$ its length. Head compressed, upper profile little more convex and inclined. Snout about as long as broad, convex, protruding a little. Eye little longer than deep, about first $\frac{3}{7}$ in head. Mouth inferior. Mandible flattened below, horny edge depressed or flaring out. Maxillary not quite reaching eye, reaches hind nostril. Tongue obsolete. Nostrils close, near eye. Interorbital broadly convex. Rakers about $10 + 22?$, short weak fleshy points. Pseudobranchiæ equal filaments, latter about $\frac{4}{5}$ of eye. Predorsal scales 18, scarcely reduced. L. l. complete. Dorsal inserted midway between snout tip and caudal base. Anal inserted opposite depressed dorsal tip, nearer ventral origin than caudal base. Pectoral $\frac{4}{5}$ to ventral, latter inserted before dorsal or nearer snout tip than caudal base. about $\frac{2}{3}$ to anal.

Color in alcohol brownish above, faded paler, especially be-

low. Fins pale. Body overshot with brassy or light reflections.

Length 78 mm. (caudal damaged).

No. 5,989, A. N. S. P., type ? of *C. mormyrus* Cope. Bruce, Macomb County, Michigan. Though this example is a little larger than the one described by Cope, which is said to be about 2 1/2 inches long, possibly his statement is a slip for 3 1/2? It agrees in almost every respect with his short diagnosis, and his label states that it is from the Miles collection.

Head 4; depth 3 1/4; D. III, 7, 1; A. III, 6, 1; scales 50 in lateral line to caudal base and 3 more on latter; 8 scales above 1. l. and 7 below; snout 3 1/10 in head; eye 4; maxillary 3 3/5; interorbital 2 1/3; least depth of caudal peduncle 2 1/5; teeth 4-4? Body and head compressed, back a trifle convexly elevated. Snout little broader than long. Eye little longer than deep, about first 3/7 in head. Mouth inferior, horny edges of jaws depressed. Predorsal scales 22. L. 1. complete. Dorsal inserted about midway between front nostril and caudal base. Anal inserted nearer ventral base than caudal by space equal to interorbital, falls well behind dorsal base. Ventral inserted but trifle before dorsal origin.

Color in alcohol faded brownish, paler below, without markings. Fins plain pale brown.

Length 48 mm. (caudal damaged).

No. 5,986, A. N. S. P., cotype? of *C. gobioninum* Cope, Grosse Isle, Michigan. This specimen is marked as type but Cope says "one specimen is three inches long." It largely agrees, especially in squamation, etc.

Campostoma brevis Haseman has been described as a distinct species.³ It is said to differ from *C. anomalum* in the

³ Proc. Ind. Acad. Sci., 1905, p. 161. Wabash River above Wabash, Deed's Creek in Tippecanoe River Basin, and Tennessee.

shorter alimentary canal, which in a specimen 82 mm. long (without caudal) had the intestines 150 mm. long. In *C. anomalum* 81.5 mm. long (without caudal) the intestines were 360 mm., while in another 72 mm. long they were 530. A breeding male from western Pennsylvania 145 mm. long shows the intestines 515 mm. That the length of the intestines is quite variable is unquestionable. In *C. anomalum* it is claimed that the intestines are always dark and break quite easily, while those of *C. brevis* are white and not so fragile. My examples of *C. anomalum* certainly show both conditions, and also many were more or less wrapped in fatty tissue. Also in *C. anomalum* the alimentary canal wraps around the air-bladder many times, though my material shows it variable in this respect. Sometimes half the number of folds, or a half dozen or more may encircle the air-bladder. In no case could only one or two coils about the air vessel be detected. Possibly an examination of a large amount of material may disclose such a condition. It is also claimed for *C. brevis* that the other folds are not spiral but longitudinal, and in this both conditions were noticed, though the lengthwise folds variable. Further, my material often showed the anterior folds variable, as several were even noticed encircling the hind portions of the liver, and others showed them loose or inclined. Some dissections revealed the alimentary canal like a continuous even coil, even posteriorly or where the air-bladder did not extend. Often the coils were between a dozen and eighteen to twenty in number.

An examination of the above typical nominal species described by Cope shows that they fall within the limits of *C. anomalum* in the arrangement of their alimentary canals, which have a dozen or more coils and half at least around the air-

bladder. Granting *C. brevis* is distinct on the basis of the modified alimentary canal, it is certainly covered in all other characters by my series of *C. anomalum*.

Hybognathus nuchalis Agassiz

Hybognathus nuchalis Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 284. Grosse Isle.

Pimephales promelas Rafinesque

Pimephales promelas Cope, l. c., p. 282. Near Lansing.

Pimephales milesii Cope, l. c. *Grosse Isle, Detroit River.*

Head $3 \frac{3}{5}$; depth $3 \frac{2}{3}$; D. III, 7, 1; A. III, 6, 1; scales 40 in median lateral series to caudal base and 2 more on latter; about 14 scales transversely between dorsal and anal origins; 22 predorsal scales; head width $1 \frac{4}{7}$ its length; head depth $1 \frac{1}{3}$; snout 3; eye $3 \frac{7}{8}$; maxillary $3 \frac{2}{3}$; interorbital $2 \frac{1}{3}$; second branched dorsal ray $1 \frac{3}{4}$; second branched anal ray $2 \frac{1}{4}$; least depth of caudal peduncle $2 \frac{1}{8}$; upper caudal lobe about 1; pectoral $1 \frac{2}{5}$; ventral $1 \frac{3}{4}$.

Body rather fusiform or with similar profiles. Least depth of caudal peduncle $1 \frac{3}{4}$ in its length. Head rather broadly conic, sides somewhat compressed or flattened though not constricted below. Snout broadly convex, length $\frac{2}{3}$ its width. Eye circular, high and about first $\frac{2}{5}$ in head. Maxillary inclined, reaches about opposite hind nostril. Lips fleshy and mandible rather broad, not very convex. Nostrils together on snout, above and just before eye. Interorbital broadly convex, depressed medianly. Preopercle with rather abrupt angle. Preorbital about as long as eye. Teeth 4 - 4, slender, scarcely hooked, tips pointed, with well developed concave grinding surfaces. L. 1. present only as several tubes anteriorly and extending about half way to dorsal. Dorsal origin nearer caudal base than snout tip by length of latter. Anal origin inserted

just behind last anal ray base, fin small. Pectorals reach about $2/3$ to ventrals. Latter inserted trifle before dorsal origin or about midway between front nostril and caudal base.

Color in alcohol brownish, becoming paler on sides and still more so below. Iris brassy. Fins all pale brownish white.

Length 52 mm. (caudal damaged).

Lansing, Michigan (Prof. Manley Miles), E. D. Cope.

The type of *Pimephales milesii* Cope I have not located.

Pimephales notatus (Rafinesque)

Hyborhynchus notatus Cope, l. c., p. 282. Grosse Isle, Detroit River.

Eight examples from Grosse Isle (Prof. Fox) and one from Ann Arbor. These all agree with large series of examples from the Middle Atlantic States, and the intestine appears to average $1\ 1/2$ times the length of the fish. *Pimephales anuli* Kendall⁴ also agrees in its similar intestine but differs in its deeper body and incomplete lateral line, characters in which it approaches *Pimephales promelas*.

Semotilus atromaculatus (Mitchill)

Semotilus corporalis Cope, l. c., p. 277. Near New Hudson, Oakland County; Swartz Creek, Genesee County; Grosse Isle.

Nineteen examples from Swartz Creek, Genesee County; Grosse Isle and Houghton Lake.

Leuciscus elongatus (Kirtland)

PLATE 5

Squalius proriger Cope, l. c., p. 280. *Exact locality in Michigan not stated.*

Head $3\ 3/4$; depth $4\ 2/5$?; D. III, 7, 1; A. III, 8, 1; scales 62 in lateral line to caudal base and 3 more on latter; 25 predorsal scales; 10 scales above 1. 1. to dorsal origin, 7 below to

⁴Bull. U. S. Fish Com., XXII, 1902 (1904), p. 360, fig. Cross Lake, Thoroughfare and Lunkasoos Lake, Maine.

anal origin; snout about 3? in head measured from upper jaw tip; eye $3 \frac{3}{5}$; maxillary $1 \frac{4}{5}$; interorbital about $3 \frac{1}{2}$.

Body elongate, well compressed and greatest depth apparently at dorsal origin. Caudal peduncle compressed, least depth about half its length. Head conic, pointed, rather broadly convex above and becomes scarcely constricted below convexly. Snout long, convex and its length about $\frac{7}{8}$ its width. Eye circular, high and a trifle anterior in head. Mouth large, well inclined so that profile more oblique than that of snout above. Mandible large, protruding. Maxillary long, slender, more or less concealed and reaches a little beyond front edge of pupil though not quite to middle. Nostrils superiorly lateral on snout, posterior larger and in crescent. Interorbital space rather broadly convex. Preorbital large, its width but a trifle less than its length, and latter $1 \frac{1}{5}$ in eye. Gill-rakers few weak short points. Teeth ? - 4, 1?, hooked, slender, without grinding-surfaces. Scales moderately small, disposed in lengthwise rows parallel with l. l. and not crowded before dorsal. L. l. of simple tubes, continuous and a little decurved at first. Dorsal origin little nearer caudal base than snout tip. Anal inserted just behind last dorsal ray base.

Color faded uniform brownish in alcohol. Fins pale. Iris slightly silvery.

Length 73 mm. (caudal damaged).

No. 22,316, A. N. S. P., cotype of *Squalius proriger* Cope. Exact locality in Michigan not stated. E. D. Cope. This specimen is greatly damaged.

Leuciscus neogæus (Cope)

PLATE 6

Phoxinus neogæus Cope, Trans. Amer. Philos. Soc. Phila., (2) XIII, 1866, p. 375. *New Hudson, Michigan*.

Chrosomus eos (non Cope 1861) Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 281 (cotypes).

Head $3 \frac{3}{5}$; depth 4; D. III, 8, 1; A. III, 7, 1; scales about 76 in lateral line to caudal base and 4 more on latter; tubes in l. l. about 28; 45 predorsal scales; 18 scales from near end of l. l. obliquely up to dorsal origin; 10 scales obliquely from ventral origin to l. l.; head width $1 \frac{7}{8}$ its length; head depth at occiput $1 \frac{2}{7}$; snout 4; eye $3 \frac{1}{3}$; maxillary $2 \frac{3}{5}$; interorbital $2 \frac{3}{4}$; first branched dorsal ray $1 \frac{1}{2}$; anal ray $1 \frac{7}{8}$; least depth of caudal peduncle $2 \frac{1}{3}$; lower caudal lobe about $1 \frac{2}{7}$; pectoral $1 \frac{3}{5}$; ventral $1 \frac{4}{5}$.

Body rather robust anteriorly, predorsal profile well convex. Caudal peduncle rather stout, well compressed, its least depth about half its length. Head robust, more especially broad and convex above. Snout broadly convex, length about $\frac{3}{5}$ its width. Maxillary reaches front pupil rim. Tongue scarcely free. Preorbital small, its length about $1 \frac{1}{2}$ in eye, and other suborbitals narrow. Gill-rakers $2 + 6$. Teeth 2,5 - 4,2, without grinding surfaces. Scales a little smaller along dorsal and ventral edges of body. L. l. only extending to opposite dorsal origin. Anal inserted just behind base of last dorsal ray. Pectoral reaches $\frac{3}{5}$ to ventral and latter not quite to anal.

Color in alcohol brownish on back, sides and lower surface a dull leaden or silvery-gray. A brown lengthwise band about equal to orbit in width and of shade of back, extends to caudal where it forms a small black spot, in size little smaller than pupil. Iris dull slaty. Fins all pale brown.

Length 67 mm.

No. 4,548, A. N. S. P., cotype (type) of *Phoxinus neogaeus* Cope. New Hudson, Livingston County, from streams flowing into Lake Erie, Michigan.

Also 37 examples, small and in poor preservation.

Abramis crysoleucas (Mitchill)

Plargyrus americanus Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 281. Saginaw Bay and Grosse Isle, Detroit River.

Seven examples from Grosse Isle, Michigan, and Lake Michigan. Mr. Morgan Hebard also obtained it at Pequam-ing in Lake Superior, Baraga County.

Ceraticthys vigilax Baird and Girard

PLATE 7

Hybopsis tuditans Cope, Trans. Amer. Philos. Soc. Phila., (2) XIII, 1866, p. 381. Detroit River, Michigan.

Head 4; depth $4 \frac{1}{2}$; D. III, 7, 1; A. III, 6, 1; P. 1, 15; V. 1, 7; scales 42 in lateral line to caudal base and 2 more on latter; 7 scales above 1. l. to dorsal origin, 4 below to ventral origin, and 5 below to anal; 23 predorsal scales; head width $1 \frac{7}{8}$ its length; head depth $1 \frac{1}{2}$; snout $3 \frac{1}{8}$; eye $3 \frac{1}{2}$; maxillary $3 \frac{3}{4}$; mandible $3 \frac{1}{10}$; interorbital $2 \frac{4}{5}$; first branched dorsal ray $1 \frac{2}{3}$; anal ray 2; least depth of caudal peduncle $2 \frac{1}{4}$; upper caudal lobe $1 \frac{1}{10}$; pectoral $1 \frac{1}{2}$; ventral $1 \frac{3}{5}$.

Body oblong, rather well compressed though with heavy or somewhat stout appearance, deepest at dorsal origin, edges all more or less convexly rounded, and profiles alike. Caudal peduncle stout, rather well compressed and least depth about $2 \frac{2}{5}$ its length.

Head moderate, broad, robust, obtuse, width about $\frac{4}{5}$ its least depth, sides flattened to slightly converging below where also flattened convexly. Head broadly convex above and profiles alike, though lower slightly more convex. Snout obtuse, convex, length $\frac{2}{3}$ its width. Eye elongate, ellipsoid, large, high, placed at first $\frac{2}{5}$ in head. Mouth small, inferior, terminal, upper jaw very slightly protruding. Maxillary con-

cealed above, reaches front of eye. Lips rather fleshy. Pre-maxillaries protractile downward. Mandible depressed, shallow, rami well elevated inside mouth. Edges of jaws, though trenchant, rather weak. Tongue rather small, thick and hardly free. Nostrils together, lateral on snout close before upper front of eye, anterior with cutaneous rim and posterior larger. Interorbital broad and but slightly convex. Preorbital $1 \frac{2}{5}$ in eye, elongate or its greatest width about $\frac{3}{4}$ its length. Other suborbitals all moderate in width. Hind preopercle edge inclined a little in front, nearly straight, and at corner would form a slightly obtuse angle.

Gill-opening extending forward about opposite hind edge of preopercle, and width of isthmus at that point $1 \frac{1}{3}$ in eye. Gill-rakers about $3 + 7^?$, short weak rudimentary points. Gill-filaments large, $1 \frac{1}{4}$ in eye. Pseudobranchiæ about $\frac{2}{3}$ of largest gill-filaments. Isthmus broad, its surface nearly level or only very slightly convex. Teeth 4-4, compressed, rather lanceolate or with tips but slightly curved over and grinding-surfaces well developed, broader below.

Scales large, rhomboidal vertically, well exposed, of more or less equal size except along median predorsal region where smaller and crowded, and disposed in rows parallel lengthwise with l. l. Rather broad adnate scale in ventral axilla. Each scale on body usually with very fine radiating striæ. L. l. continuous, of simple tubes with each one extending to edge of scale, and its course nearly straight or about midway along side, but very slightly decurved at first.

Dorsal origin about midway between hind nostril and caudal base, and graduated down from first branched ray, which highest. Second simple dorsal ray separated from third by membrane of rather broad space. Anal origin inserted just behind last dorsal ray base, and first branched ray highest

with others graduated down. Caudal deeply emarginate, broad lobes rounded, and upper trifle longer than lower. Pectoral rather long, uppermost rays longest, reaches $\frac{3}{5}$ space to ventral. Latter inserted trifle before dorsal, reaches about $\frac{3}{4}$ to anal. Vent close before anal.

Color in alcohol faded dull brownish, trunk more or less unicolor or back scarcely darker. Pale gray, leaden streak from level with eye below shoulder to middle of caudal base, and in this course traces of dull olive-brown band beginning on side of snout coursing through eye along upper side of head and back to caudal, at bases of median rays of which jet-black spot size of pupil. Side of head and under surface whitish with silvery reflections. Also silvery reflections on lower side of trunk. Iris silvery to whitish, except where dark lateral band crosses. Fins all plain pale brownish. Traces of a dusky blotch at tip of second simple dorsal ray which extends on two following rays at this point. Also outer ends of dorsal rays pale brownish.

Length 70 mm.

No. 5,019, A. N. S. P., cotype of *Hybopsis tuditans* Cope, in the Detroit River. E. D. Cope. Also Nos. 5,020 and 5,021, same data, and 41 examples from Grosse Isle.

Notropis heterodon (Cope)

Alburnops heterodon Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 281. *Lansing and Grosse Isle.*

Although the types are now lost Mr. Hebard procured it at Pequaming, Baraga County.

Notropis fretensis (Cope)

Hybopsis fretensis Cope, Trans. Amer. Philos. Soc. Phila., (2) XIII, 1866, p. 382. *Near Detroit.*

Notropis fretensis Fowler, Proc. Acad. Nat. Sci. Phila., 1910, p. 274, Pl. 15, fig. 3 (type).

Head 4; depth 4; D. III, 7, 1; A. III, 7, 1; P. I, 11; V. I, 7; scales 36 (damaged) in lateral series to caudal base and 2 more on latter; 7 scales above 1. 1. to dorsal origin, 4 below to anal origin; 17 predorsal scales; head width 2 in its length; head depth $1 \frac{2}{5}$; snout $3 \frac{1}{3}$; eye $3 \frac{1}{3}$; maxillary $3 \frac{1}{10}$; interorbital $2 \frac{2}{5}$; first branched dorsal ray $1 \frac{1}{10}$; first branched anal ray $1 \frac{2}{5}$; least depth of caudal peduncle $2 \frac{1}{5}$; upper caudal lobe (damaged) 1; pectoral $1 \frac{1}{5}$; ventral $1 \frac{2}{5}$.

Body elongate, compressed, profiles similar with contour fusiform, deepest at dorsal origin and edges all convexly rounded. Caudal peduncle compressed, least depth $1 \frac{4}{5}$ its length.

Head moderately compressed, lower profile little more inclined, sides flattened and slightly converge below. Snout short, convexly rounded over surface and in profile near tip, and its length about $\frac{3}{5}$ its width. Eye circular, little above midway in depth of head, and center falls about first $\frac{2}{5}$ in head length. Mouth well inclined, moderate in size, and lower jaw slightly protrudes when closed. Premaxillaries protractile. Maxillary long, slightly curved, rather slender, more or less concealed above, and reaches front edge of eye. Lower jaw moderately convex, with very slight knob at symphysis and rami well elevated inside mouth. Lips little developed, jaw edges rather horny and trenchant, though upper more so. Tongue thick, fleshy, little free. Nostrils large, together, posterior much larger and placed close to upper front edge of eye. Interorbitals rather broad and convexly depressed. Preorbital large, its width about $\frac{2}{3}$ its length and latter $1 \frac{2}{7}$ in eye, other suborbitals all narrower. Hind preopercle edge nearly straight, and inclined a little anteriorly.

Gill-opening extending forward about opposite last $\frac{2}{5}$ in

head, though not quite to hind edge of eye. Gill-rakers about $2 + 6$? weak and rather conic points, much shorter than gill-filaments. Last trifle less than eye. Pseudobranchiæ about $2/5$ of eye. Isthmus rather broad and depressed. Teeth ? extracted.

Scales large, cycloid, with numerous concentric striæ, of mostly uniform size, and placed in lengthwise rows parallel with 1. 1. Predorsal scales now crowded, though those on base of caudal and breast little smaller than elsewhere. No scaly axillary ventral flap. L. 1. complete, decurved little at first, low along side of caudal peduncle and reaches middle of caudal base; tubes simple, extend well over each scale, though not quite to its edge.

Dorsal origin nearer caudal base than snout tip by space equal to snout length, graduated down from first branched ray, which highest, and depressed fin reaches half way to caudal base. Anal inserted just behind last dorsal ray base, first branched ray longest with others graduated down and depressed fin reaches about $3/5$ to caudal base. Caudal well emarginated, lobes (damaged) apparently of about equal length. Pectoral long, slender, pointed, uppermost rays longest and fin reaches $3/4$ to ventral. Last inserted slightly before dorsal origin, fin rather long and pointed, and reaches anal origin. Vent close before anal.

Color in alcohol pale brownish, more or less uniform, scarcely more pale below than above. Sides of head, especially cheek and opercle, with brassy and silvery reflections. Upper surface of head darker than lower. Iris dull brassy, also pupil. Fins all pale or dull uniform brownish.

Length 58 mm. (caudal damaged).

No. 2,840, A. N. S. P., type of *Hybopsis fretensis* Cope. Near Detroit, Michigan. E. D. Cope.

Cope states that the maxillary does not attain the line of the orbit, which is only true when the mouth is closed, as the distal portion seen when the mouth is closed is not the end, though even then it is very close. The pharyngeal teeth are said to be more or less crenate and the inference according to his key is that they would be 4-4. The external angle of the pharyngeal bone is said to be scarcely projecting.

Notropis deliciosus (Girard)

Hybognathus stramineus Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 283. *Grosse Isle*.

Notropis deliciosus Fowler, Proc. Acad. Nat. Sci. Phila., 1910, p. 274, Pl. 15, fig. 5 (type of *H. stramineus* Cope).

Head $3 \frac{7}{8}$; depth $4 \frac{1}{5}$; D. III, 7, 1; A. III, 6, 1; scales 34 in lateral line to caudal base and 3 more on latter; 5 scales above 1. 1. to dorsal origin, 4 below to ventral and 4 below to anal; 14 predorsal scales; snout $3 \frac{2}{5}$ in head; eye $2 \frac{4}{5}$; maxillary $3 \frac{1}{5}$; interorbital 3; first branched dorsal ray 1 $\frac{1}{8}$; first branched anal ray about 2; least depth of caudal peduncle $2 \frac{2}{3}$; pectoral 1 $\frac{1}{3}$; ventral 1 $\frac{3}{4}$.

Body moderately elongate, well compressed, profiles similar and greatest depth at dorsal origin. Caudal peduncle compressed, least depth about $2 \frac{1}{5}$ its length. Head moderate, muzzle obtuse. Snout convex over surface, length $\frac{2}{3}$ its width, very slightly protrudes beyond lower jaw. Eye large, deeply ellipsoid, high, its center about first $\frac{3}{8}$ in head length. Mouth little inclined, moderately large. Lower jaw slightly included in upper jaw and with slight prominence at symphysis below. Premaxillaries protractile downward. Maxillary reaches very slightly beyond front of eye, though when closed appears to barely attain to it. Jaw edges tough, firm, little trenchant. Tongue adnate, fleshy. Nostrils near upper front of eye, hind one crescentic. Interorbital broad, very

depressed and but slightly convex. Preorbital trapezoidal, greatest width $\frac{4}{5}$ its length and latter 2 in eye. Suborbitals all narrow. Hind preopercle edge slopes little forward. Gill-opening extends forward trifle before hind edge of eye. Gill-rakers $2 + 4$ short weak points. Pseudobranchiæ large, but little shorter than longest gill-filaments. Teeth 4-?, curved little at tips and with slight grinding-surfaces. Scales cycloid, mostly uniform or but little smaller on caudal base, predorsal region and breast, and each with number of radiating striæ. Ventral axillary scale small, adnate. L. 1. continuous, but very little decurved on costal region, and midway along side of caudal peduncle. Tubes simple and each one extends well over exposure of scale for about first $\frac{2}{3}$ its space. Dorsal origin midway between front nostril and caudal base; first branched ray longest and depressed fin reaches half way to caudal base. Anal inserted well behind last dorsal ray base, first branched ray longest and depressed fin reaches half way to caudal base. Caudal (damaged) evidently well forked. Pectoral pointed, upper rays longest and reach $\frac{3}{4}$ to ventral origin. Ventral inserted trifle before dorsal origin, reaches $\frac{2}{3}$ to anal. Vent close before anal.

Color faded in alcohol to pale brownish, and under surface scarcely paler. Side and lower surface of head, and broad band along side to caudal base silvery-white. Lower surface of body tinted here and there with silvery. Fins all uniform pale brownish. Iris pale creamy.

Length 63 mm. (caudal damaged).

No. 4,131, A. N. S. P., cotype (type) of *Hybognathus stramineus* Cope. Grosse Isle, Detroit River, Michigan. (Prof. Manly Miles) E. D. Cope. Also Nos. 4,132 to 4,136, A. N. S. P., cotypes, same data.

The specimen selected as the type differs a little from Cope's account. Head said to enter length to caudal a little over 4 times; depth $4 \frac{3}{4}$; eye 3; dorsal inserted nearer end of muzzle than caudal base. A small label, evidently in Cope's handwriting, says "one specimen *P. notatus*".⁵ Also a large number of young examples, evidently the present species, from Grosse Isle and Houghton Lake.

Notropis volucellus (Cope)

Hybognathus volucellus Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 283. *Grosse Isle, Detroit River.*

Notropis hudsonius (Clinton)

Hybopsis hudsonius Cope, l. c., p. 279. Lake.

Notropis hudsonius Fowler, Proc. Acad. Nat. Sci. Phila., 1910, p. 277. Lake Michigan, Detroit and Grosse Isle.

Fifty-six examples from the above localities.

Notropis whipplii (Girard)

Notropis whipplii Fowler, l. c., p. 282, Pl. 18, fig. 28 (cotype of *Photogenis spilopterus* Cope).

Photogenis spilopterus Cope, Trans. Amer. Philos. Soc. Phila., (2) XIII, 1866, p. 378. *St. Joseph River.*

Head $3 \frac{7}{8}$; depth $4 \frac{1}{4}$; D. III, 7, 1; A. III, 7, 1; scales 32? (damaged) in lateral line to caudal base; 6 scales above l. l., 4? below; 16? predorsal scales; head width 2 in its length; head depth $1 \frac{2}{5}$; snout $3 \frac{1}{8}$; eye $3 \frac{4}{5}$; maxillary $3 \frac{1}{5}$; interorbital 3; first branched dorsal ray $1 \frac{1}{8}$; anal ray $1 \frac{2}{5}$; least depth of caudal peduncle $2 \frac{4}{5}$; median caudal rays $1 \frac{7}{8}$?; pectoral $1 \frac{1}{3}$; ventral $1 \frac{9}{10}$.

Body elongate, compressed, profiles apparently alike, deep-

⁵ Could this be *Hyborhynchus notatus* Cope, referred to on p. 15? All the above cotypes are identical specifically and I do not find *P. notatus* from Grosse Isle.

est at ventral origin. Caudal peduncle compressed, least depth about half its length. Head compressed, flattened sides converging below, and lower profile little more inclined. Snout convex, length about $\frac{4}{5}$ its width. Eye rounded, high, about first $\frac{2}{5}$ in head. Mouth inclined, lower jaw slightly included. Maxillary rather slender, well inclined, reaches eye. Lower jaw rather shallow. Tongue fleshy, adnate. Nostrils together, posterior larger. Interorbital broadly convex. Preorbital about equals eye. Hind preopercle edge vertical. Gill-opening last $\frac{2}{5}$ in head. Rakers (damaged) pointed, moderate, firm. Filaments and pseudobranchiæ moderate. Teeth 1,4-4,1, hooked, with entire grinding-surfaces. Scales mostly narrowly imbricated, striæ radiating, series parallel with 1. 1., little smaller on breast. L. 1. continuous, decurved, little low along side of caudal peduncle at first. Tubes simple, well over scale exposures. Dorsal origin little nearer caudal base than snout tip. Anal origin slightly after dorsal base. Caudal (damaged) evidently emarginate. Pectoral long, slender, $\frac{2}{3}$ to ventral. Latter inserted little before dorsal, reaches vent, which close to anal.

Color in alcohol faded mostly uniform dark brownish. Sides of trunk leaden. Head sides silvery tinted, Iris dull leaden. Fins pale brownish, upper hind part of dorsal with slightly dusky tint.

Length 57 mm. (caudal damaged).

No. 22,901, A. N. S. P., cotype of *Photogenis spilopterus* Cope. St. Joseph River in southwestern Michigan. E. D. Cope.

Cope gives eye $3\frac{1}{2}$ in head. He also says "median part of caudal fin, a spot on the upper hinder portions of the dorsal, and a narrow vertebral line black", all of which cannot be satisfactorily determined in my example. Otherwise his account agrees.

Notropis cornutus (Mitchill)

Hypsilepis cornutus Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 279. Pine Lake, Emmet County; Bruce, Macomb County; Swartz Creek.

Notropis cornutus Fowler, Proc. Acad. Nat. Sci. Phila., 1910, p. 283, Pl. 18, fig. 30. Pine Lake, Grosse Isle, Flint and Belle Isle. (Type of *Alburnopus plumbeolus* Cope).

Hypsilepis frontalis Cope, l. c., p. 279. Grosse Isle, Detroit River; Three Mile Lake and Waterford, Oakland County; Swartz Creek, Genesee County; Monroe County.

Alburnops plumbeolus Cope, l. c., p. 282. Flint.

Head $3 \frac{3}{4}$; depth $4 \frac{1}{4}$; D. III, 7, 1; A. III, 7, 1; P. I, 12; V. I, 7; scales 35 in lateral line to caudal base and 2 more on latter; 6 scales above l. 1., 3 ? below; 14 predorsal scales; head width 2 in its length; head depth $1 \frac{3}{5}$; mandible $2 \frac{1}{2}$; first branched dorsal ray $1 \frac{1}{10}$; third simple anal ray $1 \frac{1}{3}$; least depth of caudal peduncle $2 \frac{1}{4}$; pectoral $1 \frac{1}{3}$; ventral $1 \frac{1}{5}$; snout $3 \frac{2}{3}$ in head measured from upper jaw tip; eye $2 \frac{3}{4}$; maxillary $3 \frac{2}{5}$; interorbital $2 \frac{7}{8}$.

Body elongate, well compressed, rather slenderly fusiform, greatest depth at dorsal origin, profiles similarly convex and edges evenly so. Caudal peduncle compressed, least depth about $1 \frac{3}{4}$ in its length.

Head compressed, sides flattened somewhat and converging a little below, and upper profile little more convex than lower. Snout convex over surface, its length $\frac{3}{4}$ its width. Eye large, ellipsoid, its width about $\frac{4}{5}$ its length, and center falls near first $\frac{2}{5}$ in head. Mouth terminal, rather small, inclined, and lower jaw well protrudes in front. Premaxillaries protractile down anteriorly. Maxillary slender, more or less concealed, and reaches front edge of eye. Jaw edges thin, tough. Lips thin. Tongue thick, fleshy, not free. Mandible depressed, rami scarcely elevated inside mouth. Nostrils together on upper side of snout close in front of eye,

posterior much larger and anterior with cutaneous rim. Interorbital broadly depressed and very slightly convex. Preorbital a little long, width $\frac{3}{4}$ its length and latter 2 in eye horizontally. Postorbital width about $1 \frac{1}{4}$ in pupil, other suborbitals all narrow. Hind preopercle edge slightly convex and inclined anteriorly.

Gill-opening extends forward to about middle of head or opposite hind edge of pupil. Gill-rakers about $2 + 6$ short weak points, much shorter than longest filaments, about $\frac{1}{4}$? their length. Gill-filaments 2 in eye horizontally, pseudo-branchiæ 2 $\frac{1}{2}$. Teeth 2 ?, 4-?, ?, hooked and with slight grinding-surfaces.

Scales in lengthwise rows parallel with l. l., mostly uniform or all rather broadly exposed, and those on chest slightly smaller. Predorsal scales not crowded. L. l. complete, decurved nearly to lower third in greatest depth and ascends a little low at first along side of caudal peduncle. Tubes simple, extend well over exposures of scales or for first $\frac{3}{4}$ at least.

Dorsal origin about midway between front nostril and caudal base, graduated down from first branched ray which longest, depressed fin reaching $1 \frac{4}{5}$ to caudal base. Anal origin behind last dorsal ray, graduated down from third simple ray which highest and depressed fin reaching $1 \frac{1}{2}$ to caudal base. Caudal (damaged) apparently emarginate. Pectoral reaches $\frac{3}{4}$ to ventral origin, which opposite dorsal origin, and ventral reaches anal. Vent close before anal.

Color in alcohol faded dull brownish generally, fins and under surface paler. Lower side of head and trunk with dull silvery tints. Iris with slaty tinge, otherwise with silvery.

Length 53 mm.

No. 2,055, A. N. S. P., cotype (type) of *Alburnops plumbeolus* Cope. From Flint, a branch of the Saginaw, Michigan. E. D. Cope. Also Nos. 2,056 to 2,061, A. N. S. P., cotypes, with same data.

Cope's account differs from the above as follows: head a little over 4 to base of tail; greatest depth $4 \frac{2}{3}$; anterior base of dorsal half way between base of caudal and end of muzzle; height of dorsal less than half length from its anterior base to base of caudal; ventrals extending $\frac{2}{3}$ way to vent; scales 39 in lateral line; length 3 inches; a brownish caudal spot. Most of the other examples, however, more or less agree.

Notropis cornutus cyaneus (Cope)

Hypsilepis cornutus cyaneus Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 160. *Montreal Run, Keeweenaw Point on Lake Superior.*

Notropis cornutus cyaneus Fowler, Proc. Acad. Nat. Sci. Phila., 1910, p. 284, Pl. 18, fig. 32 (types).

Head $4 \frac{1}{8}$; depth $3 \frac{2}{5}$; D. III, 7, 1; A. III, 8, 1; P. I, 15; V. I, 7; scales 38 in lateral line to caudal base and 3 more on latter; 9 scales above l. l., 5 below to anal; 28 predorsal scales; head width 2 in its length; head depth $1 \frac{1}{4}$; snout 3; eye $4 \frac{4}{5}$; maxillary $3 \frac{1}{8}$; interorbital 3; pectoral $1 \frac{2}{5}$; ventral $1 \frac{3}{5}$; first branched dorsal ray $1 \frac{1}{3}$; first branched anal ray $1 \frac{5}{6}$; least depth of caudal peduncle $2 \frac{1}{2}$; lower caudal lobe 1.

Body elongate, compressed, deepest at depressed ventral tip, profiles similarly convex, edges all convexly rounded, and trunk tapers rather conspicuously from after dorsal origin. Caudal peduncle little long, compressed, least depth $2 \frac{1}{4}$ its length.

Head compressed, rather deep, obtuse, upper profile more inclined than lower or with slight angle over front nostrils and lower more inclined and evenly convex. Sides of head flattened, not constricted below. Snout obtusely convex both in profile and over surface, width but trifle greater than its length. Eye small, rounded, high, about first $2/5$ in length of head. Mouth moderate, oblique, jaws nearly even or mandible but slightly protruding. Premaxillaries little protruded down. Maxillary narrow, concealed along its upper portion, reaches opposite hind nostril or not quite to front rim of eye. Lips thin. Mandible depressed, rather shallow, broad, and rami but little elevated inside mouth. Jaw edges rather thin, trenchant and tough. Tongue thick, fleshy and little free. Nostrils together on upper side of snout, posterior larger and exposed in crescent, and anterior with well developed cutaneous edge, placed about last third in snout length. Interorbital evenly convex. Preorbital rather rounded, its width $7/8$ its length. Postorbital width $1\ 1/4$ in eye, other suborbitals but little narrower. Hind edge of preopercle nearly straight, inclined forward.

Gill-opening extends forward to middle of head, isthmus width $1\ 4/5$ in eye horizontally. Gill-rakers $2 + 9$, slender firm points, longest about 7 in longest gill filaments. Last nearly equal eye. Pseudobranchiæ $1\ 1/2$ in eye. Teeth 2,4 - 4,2, hooked, each with well developed grinding-surfaces.

Scales very small, crowded over predorsal region of back, also on breast. Preventral scales and postventral scales next in size, those on caudal peduncle, postdorsal and postanal regions rather broadly exposed. Scales on costal region very narrowly imbricated, those on caudal base not much smaller than others. Short pointed adnate scale in ventral axil. L. 1.

continuous, ascends to middle of caudal base and descends to lowest $\frac{2}{5}$ of greatest depth. Tubes simple, extend over first half to $\frac{3}{4}$ of exposure of scale at least. Pectoral axil with deep pit. Head above, muzzle, including preorbital and sides of mandible, furnished with numerous small tubercles, though those on muzzle largest and most pronounced.

Dorsal origin about midway between snout tip and caudal base, first branched ray longest with others graduated down, and depressed fin reaches $\frac{2}{3}$ to caudal base. Anal origin well behind that of last dorsal ray, first branched ray longest with others graduated down, edge of fin nearly straight and depressed fin reaches $1 \frac{3}{4}$ to caudal base. Caudal well forked, lobes pointed, about equal. Pectoral broad, expanded, reaches $\frac{5}{6}$ to ventral origin, uppermost rays a little longer. Ventral inserted a little before dorsal origin, broadly expanded, edge rounded and fin reaches $\frac{7}{8}$ to anal. Vent close before anal.

Color in alcohol faded dull dusky brown generally, sides and lower part paler, scales on sides with dusky pockets showing at their bases. Dorsal and caudal with dusky rays, bases of fins paler. Opercles and flanks with brassy brown tinges. Other fins pale brownish basally, and largely dusky on outer portions with narrow pale milky colored edges. Iris brassy gray. A dark median stripe down back.

Length 153 mm.

No. 3,950, A. N. S. P., cotype (type) of *Hypsilepis cornutus cyaneus* Cope. Montreal Run, Keeweenaw Point on Lake Superior. Dr. J. H. Slack. Also Nos. 3,951 to 3,959, cotypes, same data.

Cope gives the scales before the dorsal as 31 to 40 and as $10\frac{1}{4}$ transversely; eye $4 \frac{1}{2}$ (evidently above example) in head.

Notropis atherinoides Rafinesque

Notropis atherinoides Fowler, Proc. Acad. Nat. Sci. Phila., 1910, p. 290, Pl. 20, fig. 47 (type of *Alburnellus jaculus* Cope).

Alburnus rubellus Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 282. Flint.

Alburnellus jaculus Cope, Trans. Amer. Philos. Soc. Phila., (2) XIII, 1866, p. 387. *St. Joseph River*.

No. 2,577, A. N. S. P., cotype of *A. jaculus* Cope, *St. Joseph River*, and its tributary the *Dowagiac*; these streams debouch into the head of *Lake Michigan* from the east. This example is 51 mm. long. Head compressed, flattened sides slightly converge below. Snout about broad as long. Mouth rather large. Mandible depressed, rami scarcely elevated inside mouth, symphysis included within upper jaw. Interorbital convex, about 3 in head. Gill-rakers 2 + 5 short points, 1/3 or less than filaments, latter about equal pupil. Pseudobranchiæ trifle less than filaments. Teeth 2,4-4,2, hooked, grinding-surfaces slight. Vent close before anal. Color in alcohol faded dull brownish, fins paler, caudal base medianly with obscure brown spot.

Notropis umbratilis lythrurus (Jordan)

Notropis umbratilis lythrurus Fowler, l. c., p. 282. Lansing.

Hypsilepis diplæmia Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 279 (above examples).

Hypsilepis diplæmia Cope, l. c., 1867, p. 662 (same).

Two from Lansing, E. D. Cope.

Rhinichthys atronasmus (Mitchill)

Rhinichthys lunatus Cope, l. c., 1864, p. 278. *Grosse Isle*.

Hybopsis storerianus (Kirtland)

Hybopsis storerianus Cope, l. c., p. 279. Flint River at Flushing, Genesee County.

Hybopsis kentuckiensis (Rafinesque)

PLATE 8

Ceratichthys cyclotis Cope, l. c., p. 277. *Grosse Isle; Waterford, Oakland County; Clinton River and Bruce, Macomb County.*

Ceratichthys stigmaticus Cope, l. c., p. 278. *Michigan.*

Head $3 \frac{7}{8}$; depth $4 \frac{1}{8}$; D. III, 7, 1; A. III, 6, 1; scales 40 in lateral line to caudal base and 3 more on latter; 7 scales above l. l., 6 below; 21 predorsal scales; head width 2 in its length; snout $2 \frac{4}{5}$; eye 6; maxillary 6; interorbital $3 \frac{1}{10}$; first branched dorsal ray $1 \frac{1}{2}$; anal ray $1 \frac{7}{8}$; least depth caudal peduncle $2 \frac{1}{3}$; upper caudal lobe $1 \frac{1}{8}$; pectoral $1 \frac{1}{2}$; ventral $1 \frac{3}{5}$.

Body compressed, profiles alike, deepest at dorsal origin. Caudal peduncle compressed, least depth 2 in its length. Head compressed, not especially convergent above or below. Snout surface convex, also profile long as broad, slightly protruding beyond mandible. Eye trifle longer than deep, slightly before center in head length. Mouth large, low, horizontally inclined, broad. Premaxillaries protractile downward. Maxillary reaches little beyond hind nostril, not quite to eye. Jaws heavy, powerful. Lips thick, fleshy. At lower maxillary end thin pointed barbel equal to pupil. Tongue large, thick, fleshy, adnate. Mandible broad, depressed, rami scarcely elevated inside mouth. Nostrils together, posterior little larger, with cutaneous edge forming flap over posterior one. Interorbital broadly depressed, slightly convex. Preorbital ovate, width $\frac{3}{4}$ its length, latter $1 \frac{4}{5}$ in snout. Other suborbitals all narrow. Gill-opening forward last $\frac{2}{5}$ in head, isthmus width $2 \frac{1}{5}$ in snout. Rakers 3 + 7 short blunt denticles, ends mostly pectinated, length $\frac{1}{4}$ of filaments. Pseudobranchiæ large, $\frac{4}{5}$ of filaments, latter equal eye. Teeth 4-4, large,

rather obsoletely hooked, several upper with slight grinding-surfaces. Scales large, little smaller on median predorsal and breast. L. 1. continuous, midway along side. Tubes simple, extending well over scales about first half of exposed length. Dorsal origin trifle nearer hind nostril than caudal base, fin reaches half way to latter. Anal origin little behind dorsal base, fin $1 \frac{3}{4}$ to caudal base. Caudal emarginate, lobes pointed, similar. Pectoral $\frac{2}{3}$ to ventral, latter inserted opposite dorsal origin, fin $\frac{4}{5}$ to anal, not to vent which is close before anal.

Color in alcohol dull brownish, back a little darker than lower surface. Fins dull brownish, all marked with slightly darker shades of brownish on outer portions. Iris brassy.

Length 165 mm.

No. 2,113, A. N. S. P., cotype (type) of *Ceratichthys cyclothis* Cope. "Michigan". E. D. Cope. Also Nos. 2,114 to 2,117, same data.

Besides the above 13 examples from Belle Isle, Detroit, from C. Rutter, and Grosse Isle from E. D. Cope.

Coesius plumbeus (Agassiz)

PLATE 9

Ceratichthys prothemius Cope, Trans. Amer. Philos. Soc. Phila., (2) XIII, 1866, p. 365. *Montreal River, Keeweenaw Point, Lake Superior.*

Head $4 \frac{1}{4}$; depth $4 \frac{1}{8}$; D. III, 7, 1; A. III, 7, 1; scales 57 in lateral line to caudal base and 3 more on latter; 11 scales above l. 1. and 8 below; 33 predorsal scales; head width $1 \frac{3}{4}$ its length; snout $3 \frac{1}{6}$; eye $3 \frac{7}{8}$; maxillary $3 \frac{1}{3}$; inter-orbital 3; least depth of caudal peduncle $2 \frac{3}{5}$; pectoral $1 \frac{1}{5}$; ventral $1 \frac{1}{2}$.

Body elongate, compressed, deepest at dorsal origin, profiles alike, edges convexly rounded. Caudal peduncle com-

pressed, least depth $2 \frac{1}{2}$ its length. Head compressed, flattened sides scarcely converging below, upper profile inclined more than lower, rather abruptly descending in front so angle forms obtusely over nostrils. Snout surface convex, also profile length $\frac{4}{5}$ its width. Eye large, rounded, high, at first $\frac{2}{5}$ in head. Mouth low, nearly horizontal. Jaws even. Pre-maxillaries protractile downward. Maxillary reaches eye front. Lips thin, little fleshy. Slender barbel at maxillary end, about $\frac{2}{3}$ in pupil. Tongue large, thick, adnate. Mandible depressed, rami slightly elevated inside mouth. Preorbital trapezoidal, width $\frac{3}{4}$ its length, latter $1 \frac{1}{5}$ in eye. Other suborbitals all narrow. Gill-opening about midway in head, nearly forward to eye. Isthmus broadly depressed, width $1 \frac{3}{4}$ in eye. Gill-rakers $2 + 5$ short weak denticles, about 6 in filaments, latter $1 \frac{1}{2}$ in eye. Pseudobranchiæ $\frac{2}{3}$ of filaments. Teeth 2,4-4,2, slightly hooked, without grinding-surfaces. Scales smaller, rather crowded on body anteriorly, especially predorsal, preventral and breast. L. 1. complete, first slightly decurved till midway along side. Tubes simple, well exposed. Dorsal origin midway between front nostril and caudal base. Anal inserted well behind dorsal base. Pectoral $\frac{2}{3}$ to ventral, upper rays longest. Ventral inserted about opposite dorsal, reaches $\frac{4}{5}$ to anal. Vent close before anal.

Color in alcohol dull brownish generally, below paler or more brassy. Dorsal, caudal and pectoral brownish, other fins paler. Iris pale brassy.

Length 146 mm. (caudal damaged).

No. 2,152, A. N. S. P., cotype (type) of *Ceratichthys prosthemi* Cope. Montreal River, Keeweenaw Point, Lake Superior. Dr. J. H. Slack.

Also Nos. 2,153 to 2,156, same data. Head $3 \frac{1}{2}$ to $4 \frac{1}{2}$; depth 4 to $4 \frac{3}{4}$; D. III, 7, 1; A. usually III, 7, 1, seldom III, 6, 1; scales in lateral line to caudal base often 62 or 65, seldom 54, 56, 58, 63 or 64, and usually 3 more on caudal base, rarely 4; usually 11 or 12 scales above l. l., seldom 10; 7, 8 or 9 scales below l. l.; usually 34 predorsal scales, vary 28, 30, 32, 33, 35 or 36; snout $3 \frac{1}{5}$ to $3 \frac{1}{2}$ in head; eye $3 \frac{7}{8}$ to $4 \frac{1}{3}$; maxillary $2 \frac{3}{4}$ to $3 \frac{1}{3}$; interorbital $2 \frac{4}{5}$ to $3 \frac{1}{4}$; teeth usually 2,4-4,2, rarely 1,4-4,1 or 1,4-4,2; length 54 to 140 ? mm.

Platygobio gracilis (Richardson)

Hypsilepis cornutus (part) Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 279. Bruce, Macomb County (not of Mitchill).

Head about $3 \frac{3}{4}$? (caudal peduncle damaged); depth $4 \frac{3}{4}$?; scales 40 + ? in lateral line; 6 scales above l. l., 5 below; 22 predorsal scales; head width $1 \frac{4}{5}$ in its length; snout 3; eye $6 \frac{1}{2}$; maxillary $2 \frac{4}{5}$; interorbital $2 \frac{1}{4}$.

Body elongate, compressed, back slightly elevated, and caudal peduncle rather long. Head broad as deep, sides not converging below. Snout broad, depressed, length about $\frac{2}{3}$ its width. Eye small, lateral, hind edge slightly before middle in head length. Mouth large, nearly horizontal, lower jaw included within upper and snout tip slightly protrudes. Maxillary barbel terminal, nearly as long as diameter of pupil. Lips rather firm. Tongue broad, thick, adnate. Mandible shallow, rami little elevated inside mouth. Nostrils large, together, close before eye, hind one crescentic. Preorbital elongate crescent, long as $1 \frac{1}{2}$ eye diameters. Other suborbitals all narrow. Preopercle edge free. Interorbital broadly convex, depressed medianly. Gill-rakers 1 + 5 short weak points. Gill-filaments nearly long as eye, pseudobranchiæ little smaller. Scales rather large, cycloid, all well exposed,

mostly of uniform size, or smaller on median predorsal line and breast. L. 1. extends only as far as last anal ray, slightly decurved at first, median. Tubes simple, about over first half of scale exposure. Axillary scaly flap of ventral $1/4$ its length. Dorsal (damaged) elevated in front. Anal inserted just behind last dorsal ray tip when depressed. Pectoral trifle longer than head, reaches $7/8$ to ventral. Latter inserted slightly behind dorsal origin, $1 \frac{3}{5}$ in head, and reaches vent which close before anal.

Color in alcohol pale brownish on back, sides and under surface paler. Fins all pale. Iris brassy.

Length 111 mm. (without caudal).

Bruce, Macomb County, E. D. Cope.

ESOCIDÆ

Esox vermiculatus Valenciennes

PLATE IO

Esox vermiculatus Fowler, Proc. Acad. Nat. Sci. Phila., 1916, p. 415 (type of *Esox cypho* Cope).

Esox cypho Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 78. *Waterford, Oakland County.*

Esox porosus Cope, Trans. Amer. Philos. Soc. Phila., (2) XIII, 1866, p. 408 (on above, cypho regarded inept).

Head $2 \frac{7}{8}$; depth $4 \frac{3}{4}$; D. VII, 12; A. v, 11; scales about 110 in lateral series to caudal base; 27 scales from middle of back to ventral origin, and about same between dorsal and anal origins; about 78 scales before dorsal; head width $3 \frac{1}{3}$ in its length; mandible $1 \frac{2}{3}$; snout $2 \frac{2}{3}$ in head measured from upper jaw tip; eye 7; maxillary $2 \frac{1}{4}$; interorbital $5 \frac{1}{8}$.

Body well compressed, back elevated and much broader than ventral region, profile also more convex. Caudal ped-

uncle compressed, least depth trifle less than half its length. Head well compressed, flattened sides approximated below. Snout broad, profile concave, width $1 \frac{3}{5}$ its length. Eye elevated, close to upper profile, slightly before middle in head length. Mouth large, mandible well protruded. Maxillary reaches about first third in eye, not to center. Outer front upper teeth very small. Lateral mandibular teeth large, erect, well-spaced. Tongue depressed, free at tip which slightly emarginate. Mandible shallow in front. Interorbital slightly concave. Gill-rakers numerous minute denticles or asperities. Gill-filaments about $1 \frac{2}{3}$ in eye. Branchiostegals 12. Scales smaller and more crowded on lower portion of abdomen between pectorals and ventrals. Scales in 10 rows on cheek, little larger on opercles. L. 1. as about 43 spaced notches or gashes in course of scales from shoulder to caudal base medianly. Dorsal origin little nearer ventral origin than caudal base, depressed fin $1 \frac{2}{5}$ to latter. Anal origin slightly before that of dorsal, fin similar. Caudal emarginate, small. Pectoral $3 \frac{1}{5}$ in head, $2 \frac{1}{3}$ to ventral. Last inserted nearer anal origin than that of pectoral, fin 3 in head and reaches $1 \frac{2}{3}$ to anal. Vent close before anal.

Color in alcohol largely faded uniform brownish, under surface paler or whitish. Fins brownish. Iris brassy.

Length 183 mm. (caudal tips damaged).

No. 7, 681, A. N. S. P., cotype (type) of *Esox cypho* Cope. Waterford, Oakland County. (Prof. Manly Miles) E. D. Cope.

Although "several specimens" are mentioned by Cope, the above is the only one I have examined.

Esox lucius Linnæus

Esox lucius Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 79. Michigan.
Esox lucius Fowler, l. c., 1916, p. 415. Keeweenaw Point.

Head $3 \frac{1}{6}$; depth $5 \frac{1}{2}$; D. IX, 14; A. VI, 12; scales about 105 along course of lateral line to caudal base; 13 scales above l. l., 12 below; about 90 predorsal scales; head width $3 \frac{7}{8}$ in its length; snout $2 \frac{1}{3}$ in head measured from upper jaw tip; eye $8 \frac{1}{2}$; maxillary $2 \frac{1}{8}$; interorbital $4 \frac{3}{4}$.

Body well compressed, also caudal peduncle. Head compressed, with flattened sides not approximating below. Snout broadly depressed, profile concave, width about $1 \frac{1}{2}$ its length. Eye high, about midway in center of head length. Lower jaw well protruded. Tongue depressed, rounded and free in front. Maxillary reaches about first third in pupil. Interorbital concave, depressed medianly. Branchiostegals 14. Scales smaller along caudal base and breast. Median l. l. of about 45 gashes on hind edges of scales. Also 4 or more similar parallel, irregular l. lines above and below main median course, variously complete, most prominent on side of abdomen over ventral and on caudal peduncle. Dorsal inserted slightly in advance of anal origin, fins alike. Caudal moderately emarginate. Pectoral 2 in head, $1 \frac{2}{3}$ to ventral. Latter inserted little nearer anal than pectoral origin, fin $2 \frac{3}{5}$ in head, or $1 \frac{3}{4}$ to anal. Vent close before anal.

Color in alcohol deep brownish on back, under surfaces paler. Sides with about 8 lengthwise rows of rather elongate leaden-gray spots. Also sides of head spotted with leaden gray. Iris yellowish-brown. Fins all tinged with brownish, unpaired with deep brownish to dusky blotches or obscure streaks.

Length 439 mm.

Keeweenaw Point. Dr. J. H. Slack.

The head of a much larger example with same data shows: snout $2 \frac{1}{3}$ in head measured from upper jaw tip; eye 9; maxillary 2; interorbital $4 \frac{3}{5}$.

Esox masquinongy Mitchell

Esox masquinongy Fowler, Proc. Acad. Nat. Sci. Phila., 1916, p. 415. Saginaw Bay.

Esox nobilior Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 80 (above example).

Head $3 \frac{2}{5}$; depth $5 \frac{3}{5}$; D. VII, 15; A. VI, 13, 1; scales about 152 along course of lateral line to caudal base; 16 scales above 1. l., 16 below; 120 predorsal scales; head width $3 \frac{1}{4}$ its length; snout $2 \frac{1}{6}$ in head measured from upper jaw tip; eye $11 \frac{1}{4}$; maxillary $2 \frac{1}{8}$; interorbital $5 \frac{1}{3}$.

Body, including caudal peduncle, well compressed. Head compressed, flattened sides not approximating below. Snout rather depressed, width about $\frac{2}{3}$ its length. Eye high, mid-way in length measured from upper jaw tip. Lower jaw well protruded. Tongue depressed, free, and rather obtuse in front, also slight notch medianly on front edge. Maxillary nearly reaches front pupil edge. Branchiostegals 18. Scales smaller on caudal base, scarcely so on breast. Median l. l. of about 60 gashes on hind edges of scales. Also 7 or more similar parallel irregular l. lines below main median course, fewer above, variously complete, most prominent on abdomen over ventral. Dorsal inserted slightly before anal origin, fins alike. Caudal well forked, lower lobe a little longer. Pectoral $2 \frac{1}{4}$ in head, half way to ventral. Latter inserted little nearer anal than pectoral origin, fin $2 \frac{1}{4}$ in head and slightly over half way to anal. Vent close before anal.

Color in alcohol brown on back, lower surfaces paler to whitish. Fins all with obscure darker cloudings.

Length 675 mm.

Saginaw Bay. E. D. Cope. This specimen was in poor condition.

I have not located the Grosse Isle specimen Cope lists simply as *Esox*?,⁶ which he says is "not far from the *E. affinis* (?) of Holbrook", but with "the branchiostegal and fin radial formula of *fasciatus*". Probably it was simply *E. vermiculatus*.

UMBRIDÆ

Umbra limi (Kirtland)

Melanura limi Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 78. Flint River, Grosse Isle and Oakland County.

Umbra limi Fowler, Proc. Acad. Nat. Sci. Phila., 1916, p. 415 (Oakland County material).

The few Oakland County examples are in bad condition.

PÆCILIIDÆ

Fundulus diaphanus (Le Sueur)

Fundulus multifasciatus Cope, l. c., p. 78. Frederick, Macomb County; Grosse Isle, Oakland County.

Fundulus diaphanus menona Fowler, l. c., p. 422 (Grosse Isle material).

Eleven from Grosse Isle.

Fundulus notatus (Rafinesque)

PLATE II

Fundulus notatus Fowler, l. c., p. 425 (type of *F. aureus* Cope).

Fundulus aureus Cope, l. c., p. 78. Grosse Isle.

Head $3 \frac{2}{3}$; depth $4 \frac{1}{5}$; D. II, 7; A. I, 11; P. II, 12; V. I, 5; scales 35 in median lateral series to caudal base and 3 more on latter; 11 scales between dorsal and anal origins; 28 scales before dorsal; head width $1 \frac{3}{4}$ its length; head depth $1 \frac{4}{5}$; snout $3 \frac{1}{3}$ in head measured from upper jaw tip; eye $3 \frac{2}{3}$; maxillary $3 \frac{3}{5}$; interorbital 2.

⁶ Proc. Acad. Nat. Sci. Phila., 1865, p. 79.

Body fusiform, compressed, especially behind. Caudal peduncle well compressed, its least depth about $3/5$ its length. Head broadly depressed above, its least depth about $3/5$ its length. Head broadly depressed above, upper profile nearly straight from snout tip to occiput, lower convex. Sides of head but slightly approximate below. Snout depressed, upper surface nearly level, length about $3/5$ its width. Eye rounded, high, close to upper profile, and slightly anterior to center in length of head. Mouth moderate, transverse, lateral cleft slight and little inclined. Premaxillaries greatly protractile. Maxillary not quite reaching opposite front eye edge. Lips rather thin. Teeth simple, conic, in bands in jaws, and some in outer row enlarged and slightly curved. Upper and lower inner buccal folds moderately wide, entire. Tongue depressed, elongate, end rounded and free in front. Lower jaw robust, protruded slightly beyond upper, rather depressed. Nostrils simple, close above front edge of eye. Hind preopercle edge inclined slightly backward.

Gill-opening extends forward slightly beyond hind eye edge, not quite to hind pupil edge. Gill-rakers 7, lanceolate, very short, firm, less than half of gill-filaments, which about $2/3$ diameter of eye. Isthmus narrowly constricted.

Scales moderate, with concentric striæ, enlarged on top of head, and smaller on breast, prepectoral region and caudal base. Cheek with 2 rows of scales. Lateral line obscure, complete, developed as single pore on each exposure of scale, frequently absent from a scale of its course.

Dorsal origin at last third in space between front eye edge and caudal base. Anal inserted well in advance of dorsal origin, or little nearer caudal base than pectoral origin. Caudal (damaged) apparently rounded. Pectoral moderately

high in depth, or about midway in its insertion. Ventral inserted slightly nearer snout tip than caudal base, fin about $3/5$ to anal origin. Vent close before anal.

Color in alcohol largely dull uniform brownish, paler below. A dark brown band extends from snout tip, through eye, along side to caudal base, and below dorsal broader, also below median line of depth. Fins and under surface of head all pale brownish. Iris brownish.

Length 50 mm.

No. 7,142, A. N. S. P., type of *Fundulus aureus* Cope. Detroit River, Grosse Isle. E. D. Cope.

ATHERINIDÆ

Labidesthes sicculus (Cope)

Chirostoma sicculum Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 81. Grosse Isle, Detroit River.

The type is apparently lost as it cannot now be found.

GASTEROSTEIDÆ

Eucalia inconstans (Kirtland)

Gasterosteus inconstans Cope, l. c., p. 81. Grosse Isle.

CENTRARCHIDÆ

Pomoxis sparoides (Lacépède)

Hyperistius hexacanthus Cope, l. c., p. 84. Saginaw Bay.

This example as listed by Cope cannot be located in the collection. There is, however, one received from him labeled from Lake Huron.

Ambloplites rupestris (Rafinesque)

Ambloplites rupestris Cope, l. c., p. 84. Algoma [doubtless Algonac], St. Clair County; Long Lake; Flint River.

Ambloplites rupestris Fowler, Proc. Acad. Nat. Sci., Phila., 1906, p. 513. Detroit, Michigan? Lake Superior.

A number in the collection from the localities mentioned in 1906.

Chaenobryttus gulosus (Cuvier)

Chaenobryttus gulosus Cope, l. c., p. 84. No locality given.

Chaenobryttus melanops Cope, l. c. No locality.

Lepomis megalotis (Rafinesque)

PLATE 12

Lepomis megalotis Fowler, l. c., p. 516 (cotypes of *Lepomis peltastes* Cope). Detroit, Michigan.

Lepomis peltastes Cope, Proc. Amer. Philos. Soc. Phila., XI, 1870, pp. 453-4. Huron River, Michigan.

Head $2 \frac{1}{2}$; depth 2; D. X, 10, 1; A. III, 10, 1; P., 11, 1 1; V. I, 5; scales 36 in lateral line to caudal base; 5 scales above l. l. to spinous dorsal origin, and 12 below to spinous anal origin; head width $2 \frac{1}{8}$ in its length; head depth over front eye edge 2; mandible $2 \frac{2}{3}$; fourth dorsal spine 3; fourth dorsal ray $2 \frac{1}{3}$; third anal spine $2 \frac{5}{6}$; third anal ray $2 \frac{1}{3}$; upper caudal lobe $1 \frac{2}{3}$; least depth of caudal peduncle $2 \frac{1}{3}$; pectoral length $1 \frac{1}{2}$; ventral $1 \frac{3}{4}$; snout 4 in head measured from upper jaw tip; eye $3 \frac{3}{4}$; maxillary 3; interorbital $3 \frac{3}{5}$.

Body rather deep, compressed, and profiles similarly convex. Caudal peduncle compressed, least depth trifle less than its length and about $1 \frac{1}{3}$ its greatest depth.

Head rather large, compressed, more or less broadly triangular in profile. Snout broad, short, convex. Eye rather

large, circular, its hind edge about midway in head. Preorbital narrow, about equals $2/5$ of orbit or a little less than horizontal diameter of pupil. Mouth steeply inclined, curved slightly in gape, and lower jaw projecting a little. Maxillary reaches about opposite hind nostril, and its terminal expanded end about $2/5$ of orbit. Lips rather thick and fleshy. Teeth fine, sharp pointed, in bands, outer series slightly enlarged, especially in front of upper jaw. Patch of fine teeth on vomer. No teeth on palatines or tongue. Tongue rather thick, somewhat pointed and free. Each ramus of mandible well elevated inside mouth. Nostrils separated, front one about midway in snout, hind one little larger and close to upper front orbital rim. Interorbital space broad, trifle wider than eye, more or less flattened. Suprascapula and edge of preopercle entire. Opercular flap large, about $3/4$ of eye-diameter, and osseous portion not differentiated from cutaneous.

Gill-opening extends forward about opposite front edge of orbit. Rakers I, I + 6, IV, small tubercle-like rudiments, asperous, and longest about $2/5$ of longest filaments, which about equal terminal expansion of maxillary. Isthmus constricted. Pharyngeal teeth fine, pointed, of usual type in genus.

Scales large, broadly exposed, finely ciliated, though those of head more or less entire. Cheek with 5 rows of scales, similar to occipital scales, and both smaller than opercular. Head otherwise naked and more or less porous. Scales on chest small, also those along bases of vertical fins. Along spinous dorsal and anal bases they form low scaly sheaths, though on soft portions of these fins they extend further out with those between rays becoming much smaller. Lateral line of simple tubes, more or less concurrent with upper profile,

extending a little high along side of caudal peduncle at first and not reaching on base of caudal fin.

Spinous dorsal inserted much nearer snout tip than base of last dorsal ray, edge of fin notched, spines graduated to fourth, after which mostly subequal. Soft dorsal higher, inserted nearly midway between pectoral origin and caudal base. Anal spines graduated to third, which longest, edge of fin notched, and its origin much nearer that of pectoral than caudal base. Soft anal like soft dorsal, inserted a little posteriorly. Caudal small, emarginate, so that rounded lobes distinct. Pectoral pointed, not quite reaching spinous anal origin, and upper rays longest. Ventral inserted entirely behind pectoral base, or little before spinous dorsal origin, pointed, not quite reaching spinous anal origin, spine scarcely trifle over half of space. Vent about first third of space between tip of ventral spine and spinous anal origin.

Color in alcohol dull brown, darker above, each scale also with slightly darker edges. Fins plain pale brownish, somewhat obscurely mottled. Opercular flap blackish-brown with narrow white rim. Iris pale brownish.

Length 95 mm.

No. 12,978, A. N. S. P., cotype (type) of *Lepomis peltastes* Cope. Huron River. Prof. Alexander Winchell.

Also Nos. 12,978 to 12,981, A. N. S. P., cotypes, with same data. These vary as follows: Head $2 \frac{1}{3}$ to $2 \frac{4}{5}$; depth 2 to $2 \frac{1}{8}$; D. IX or X, 11, 1 or 12, 1; A. III, 9, 1 or 10, 1; scales 31 to 36 in lateral line to caudal base; snout 4 to $4 \frac{1}{2}$ in head, measured from upper jaw tip; eye $3 \frac{3}{4}$ to $4 \frac{1}{5}$. One example with dusky ventrals.

Of the present species also one from Michigan obtained by Dr. Pitcher and three from Detroit? presented by Prof. Cope.

Lepomis incisor (Valenciennes)

Lepomis incisor Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 83. Waterford, Clinton River, Long Lake, Copenaonic Lake, Grosse Isle, Strait's Lake, Crooked Lake.

Lepomis palladus Fowler, Proc. Acad. Nat. Sci. Phila., 1906, p. 519. Detroit?

Five Michigan examples.

Pomotis gibbosus (Linnæus)

Eupomotis gibbosus Fowler, l. c., p. 520. Michigan.

Pomotis maculatus Cope, l. c. Waterford, Clinton River, Long Lake, Copenaonic Lake and Grosse Isle.

Five Michigan examples.

Micropterus dolomieu Lacépède

Micropterus fasciatus Cope, l. c. Swartz Creek, Saginaw Bay and Grosse Isle.

Micropterus salmoides (Lacépède)

Micropterus salmoides Fowler, l. c. Michigan.

Micropterus nigricans Cope, l. c. Orchard Lake, Strait's Lake, Bald Eagle Lake and Copenaonic Lake.

Three Michigan examples received from Cope.

PERCIDÆ

Stizostedion vitreum (Mitchill)

Stizostedion vitreum Fowler, l. c. Michigan.

Stizostedium americanum Cope, l. c., p. 82. Saginaw Bay.

One Michigan example received from Cope.

Perca flavescens (Mitchill)

Perca flavescens Cope, l. c. Saginaw Bay.

Two young examples were obtained at Pequaming in Lake Superior, by Mr. Morgan Hebard. These are the only Michigan examples I have examined.

Percina caprodes (Rafinesque)

Percina caprodes Cope, l. c. Grosse Isle.

Hadropterus aspro (Jordan)

Cottogaster shumardi (non Girard) Fowler, Proc. Acad. Nat. Sci. Phila., 1906, p. 521. Michigan.

Crystallaria asprella (non Jordan) Fowler, l. c., p. 524. Grosse Isle.

Head $3 \frac{2}{5}$ to $3 \frac{3}{4}$; depth $5 \frac{1}{4}$ to $5 \frac{3}{4}$; D. XIII or XIV-II, 12; A. II, 10; scales 60 to 65 in l. 1. to caudal base and 3 to 5 more on latter; 7 or 8 scales above l. 1., 8 to 10 below; about 12 predorsal scales; snout 4 to $4 \frac{1}{8}$ in head; eye 3 to 4; maxillary 3 to $3 \frac{1}{5}$; interorbital 5 to 6.

Body elongate and rather slender, compressed. Head moderate, compressed. Snout long as wide. Eye large, high. Mouth little inclined. Maxillary reaches beyond front of eye but not quite to pupil. Teeth small, in bands in jaws and on vomer and palatines, some slightly enlarged and curved. Jaws about even. Interorbital level. Gill-rakers 1 + 12, lanceolate, about 2 in filaments. Scales ctenoid, about uniform. Middle line of belly naked, also breast, prepectoral and predorsal regions. L. 1. complete, midway along side. First dorsal inserted midway between snout tip and soft dorsal origin. Latter little nearer origin of spinous dorsal than caudal base. Anal origin little behind soft dorsal origin. Caudal convex behind. Pectoral $1 \frac{1}{4}$ in head, half way to anal. Ventral $1 \frac{2}{5}$ in head, and little over half way to anal.

Color in alcohol faded brownish generally. Indistinct traces on median row of seven large dark blotches along l. 1. Fins plain brownish barred with darker, and dark spot smaller than pupil at caudal base medianly quite distinct. Lower surface paler than upper.

Larger example 55 mm.

Two examples in poor preservation and long in alcohol. These were wrongly determined, as indicated above, as the young of widely different forms. A careful and detailed examination recently shows that they are evidently young of the present species.

Etheostoma blennioides Rafinesque

Hyostoma cymatogramma Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 82. Grosse Isle.

Boleosoma nigrum (Rafinesque)

Many examples from Michigan, St. Joseph and Grosse Isle.

Pæcilichthys caruleus (Storer)

Pæcilichthys caruleus Cope, l. c., p. 82. Grosse Isle.

Etheostoma caruleum Fowler, l. c., p. 525. Ann Arbor.

Seven examples from Ann Arbor.

Pæcilichthys flabellaris (Rafinesque)

Catanotus flabellatus Cope, l. c., p. 82. Grosse Isle.

Etheostoma flabellare Fowler, l. c. Grosse Isle.

One from Grosse Isle.

SERRANIDÆ

Roccus chrysops (Rafinesque)

Roccus chrysops Cope, l. c., p. 83. Saginaw Bay.

COTTIDÆ

Cottus ictalops (Rafinesque)

PLATE 13

Potamocottus alvordii Cope, l. c., p. 81. Dexter, Washtenaw County.

Uranidea spilota Cope, l. c., p. 82. Grand Rapids, on the Grand River which flows into Lake Michigan.

Head 3; depth (distorted?) $3 \frac{7}{8}$; D. VIII, 17; A. 12; head width $1 \frac{2}{5}$ in its length; head depth at occiput $1 \frac{4}{5}$; lower jaw 2; fifth dorsal ray $2 \frac{1}{6}$; fifth anal ray $2 \frac{1}{4}$; least depth of caudal peduncle $4 \frac{4}{5}$; caudal 1 $\frac{1}{4}$; pectoral 1 $\frac{1}{6}$; ventral 1 $\frac{3}{4}$; snout $3 \frac{3}{4}$ in head measured from upper jaw tip; eye 4; maxillary $2 \frac{1}{2}$; interorbital 2 in snout.

Body elongate, rather depressed anteriorly, well compressed from vent back. Caudal peduncle rather slender, its least depth twice its length. Head rather robust, depth about $\frac{7}{8}$ its width. Snout not especially depressed, length about half its width at front edge of eyes. Eyes large, rather close together, hind edge near middle of head length. Mouth moderate, lower jaw slightly projecting. Narrow band of fine teeth in each jaw and row of small ones transversely on vomer, but none on palatines or tongue. Maxillary small, reaches back opposite middle of eye. Interorbital concave. Preopercle with a spine nearly as long as pupil curving up backward. Gill-rakers tubercular, only about 5, obsolete, on lower branch of first gill-arch. Branchiostegals 7. Skin largely smooth. L. 1. high at shoulder, slopes down till median above anal, and front tubes somewhat enlarged. Mandible and preopercle rather cavernous. Spinal dorsal begins close behind head, fin apparently low (damaged). Second dorsal begins slightly before anal origin, fins alike. Caudal apparently truncate or slightly rounded behind. Pectoral rays 13, all simple and lowermost a little stronger, reaches back nearly opposite vent. Ventral inserted about opposite base of lowermost pectoral ray, with one spine and four rays which reach $\frac{2}{3}$ to vent. Latter close before anal.

Color in alcohol faded brownish, paler on belly and under surfaces. Back with obsolete scattered darker cloudings.

Traces of indistinct dark bars on dorsal and caudal. Iris pale slaty.

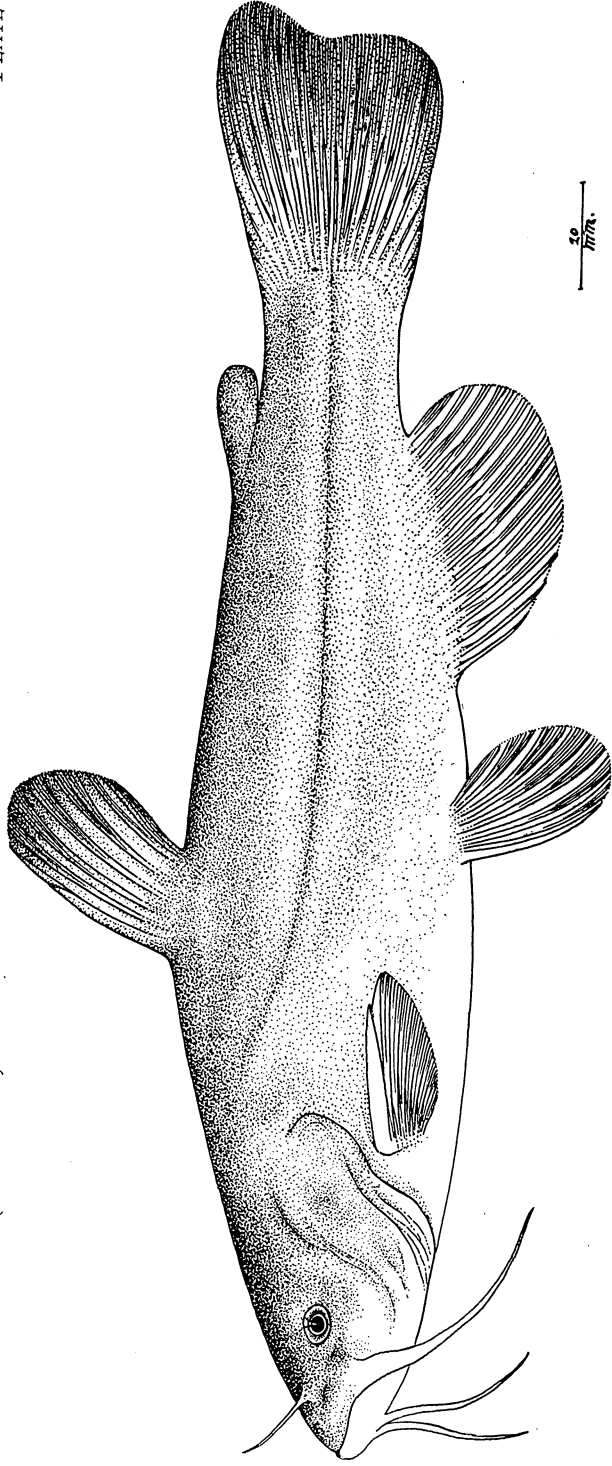
Length 60 mm.

No. 11,061, A. N. S. P., cotype (type) of *Uranidea spilota* Cope. Grand Rapids. E. D. Cope.

Also No. 11,061, same data. A smaller example, and like the above both females gravid with ova and in poor preservation. These specimens agree with our other Michigan material, from Dexter in Washtenaw County, Grosse Isle, and Ann Arbor, 5 in all. There seems little doubt to my mind that they are all identical, and for this reason I allow *U. spilota* Cope as only a synonym of the present species. Also obtained in Lake Pequaming by Mr. Hebard.

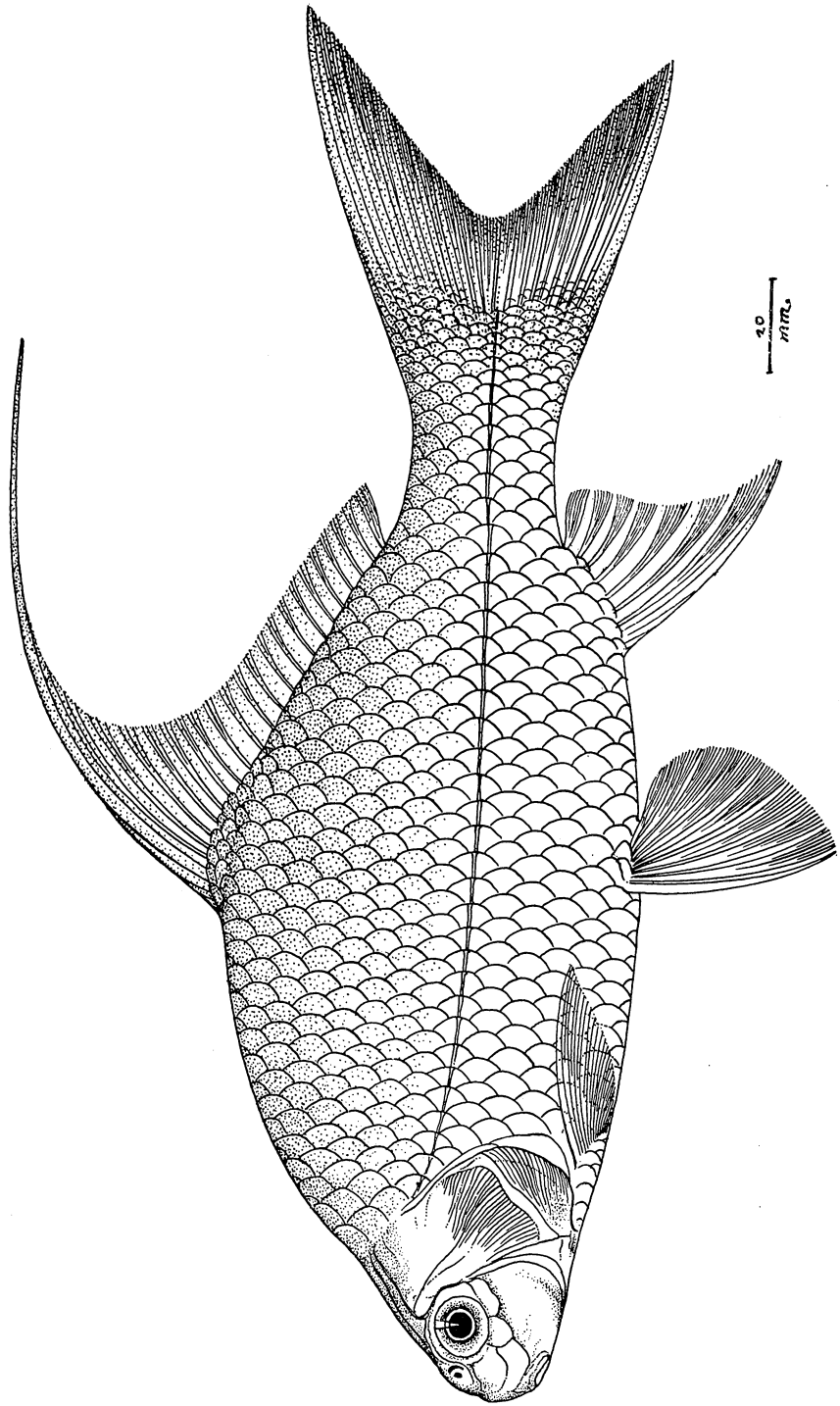
AMEIURUS VULGARIS (THOMPSON)

PLATE I



(Saginaw Bay, Michigan)

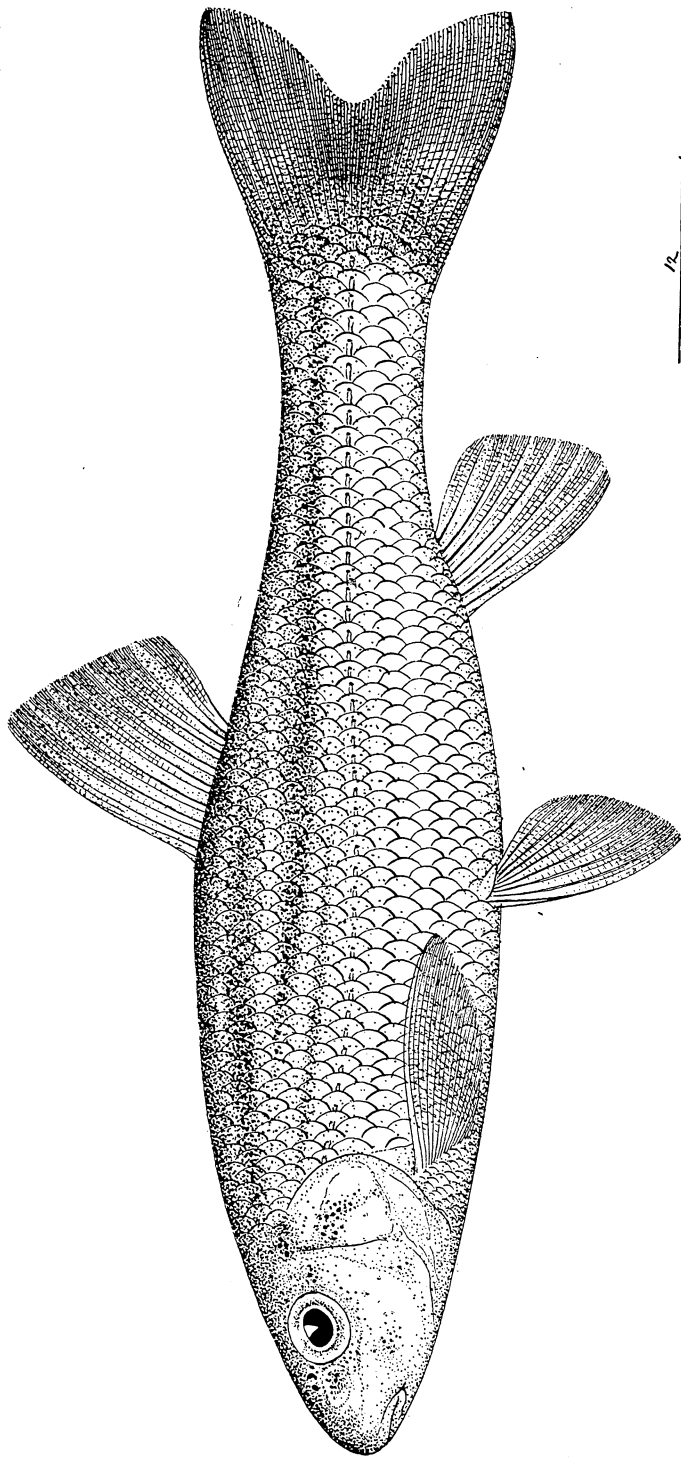




(Type)

CAMPOSTOMA ANOMALUM (RAFINESQUE)

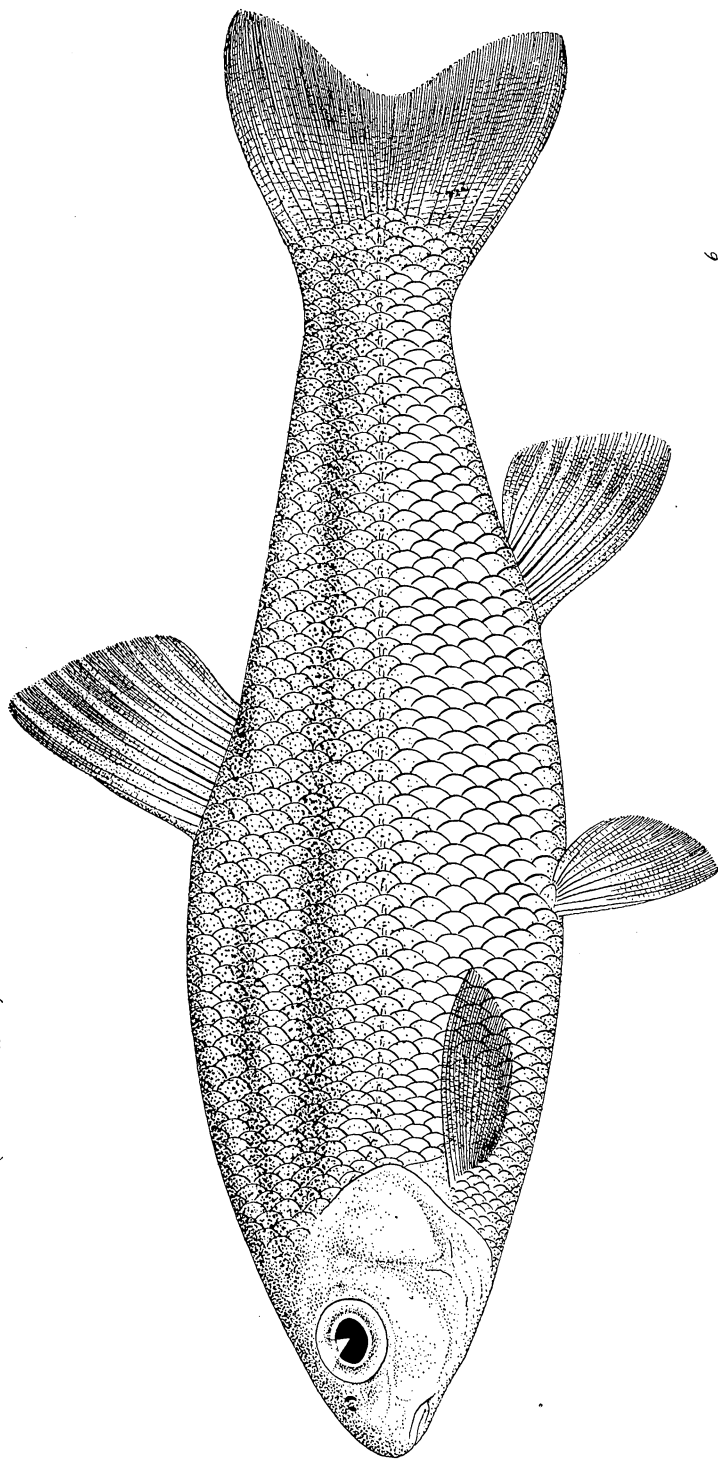
PLATE III



(? Type of *Campostoma mormyrus* Cope)

CAMPOSTOMA ANOMALUM (RAFINESQUE)

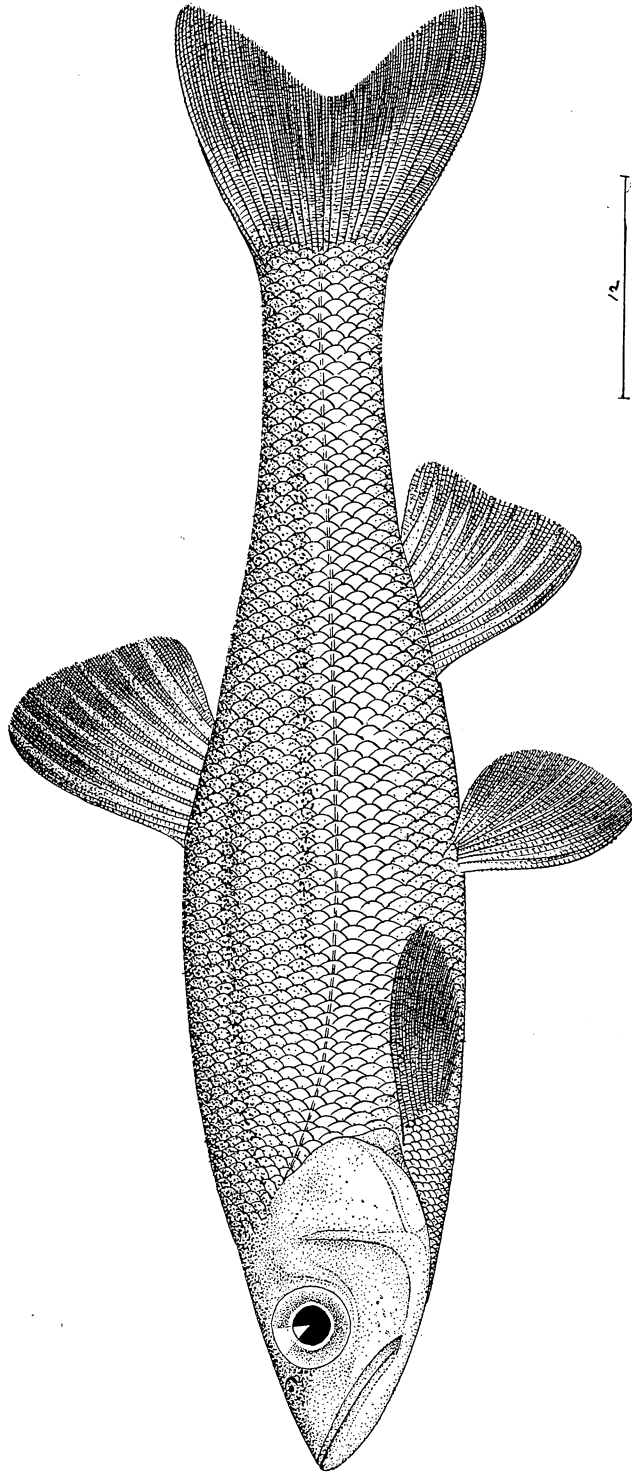
PLATE IV



(? Cotype of *Campostoma gobioninum* Cope)

LEUCISCUS ELONGATUS (KIRTLAND)

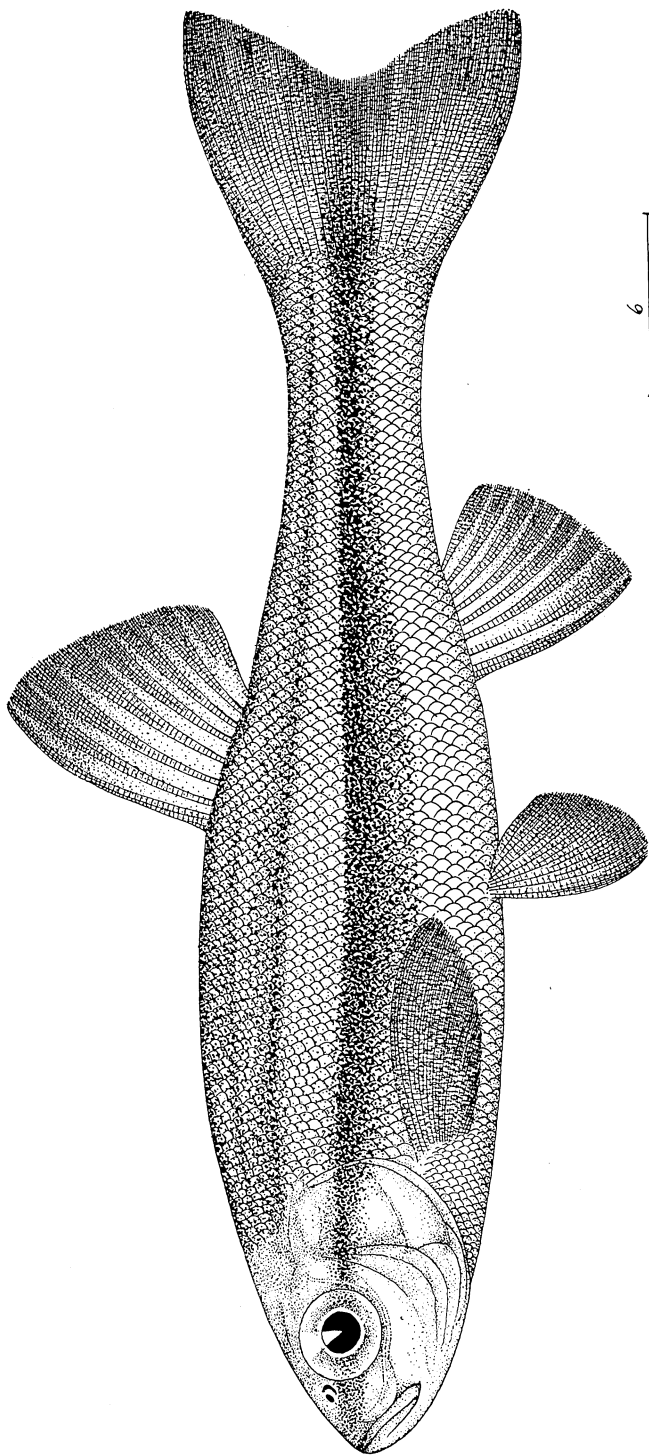
PLATE V



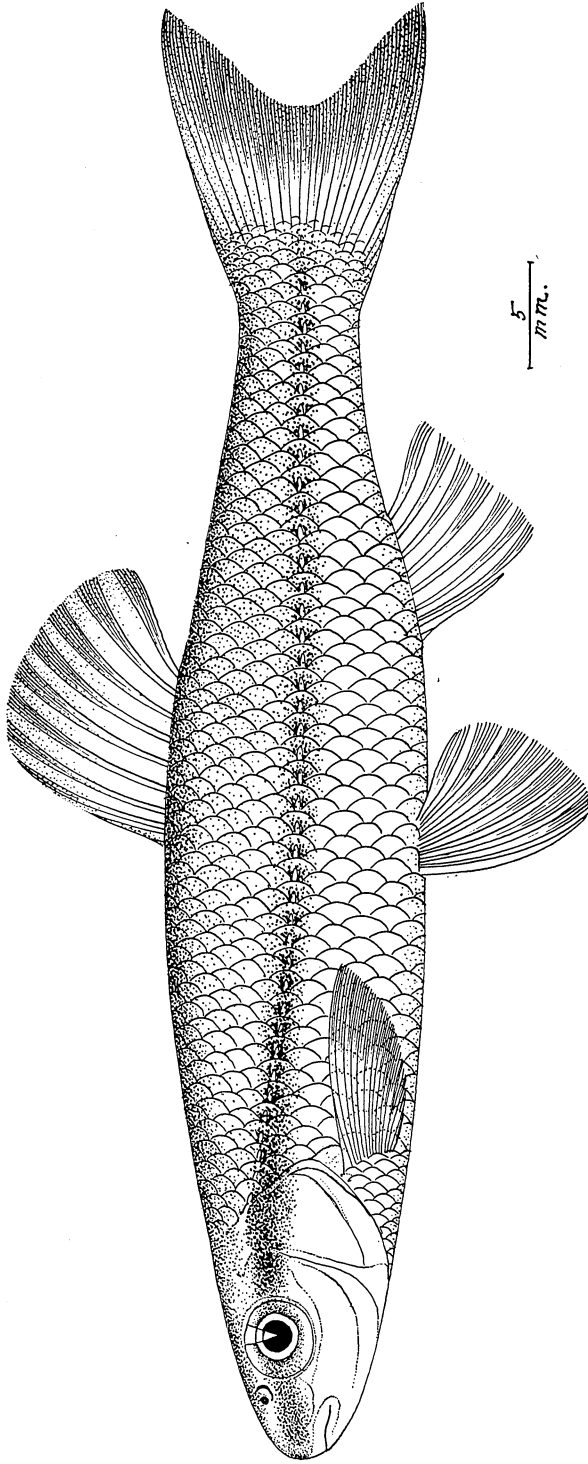
(Cotype of *Squalius proriger* Cope)

LEUCISCUS NEOGÆUS (COPE)

PLATE VI



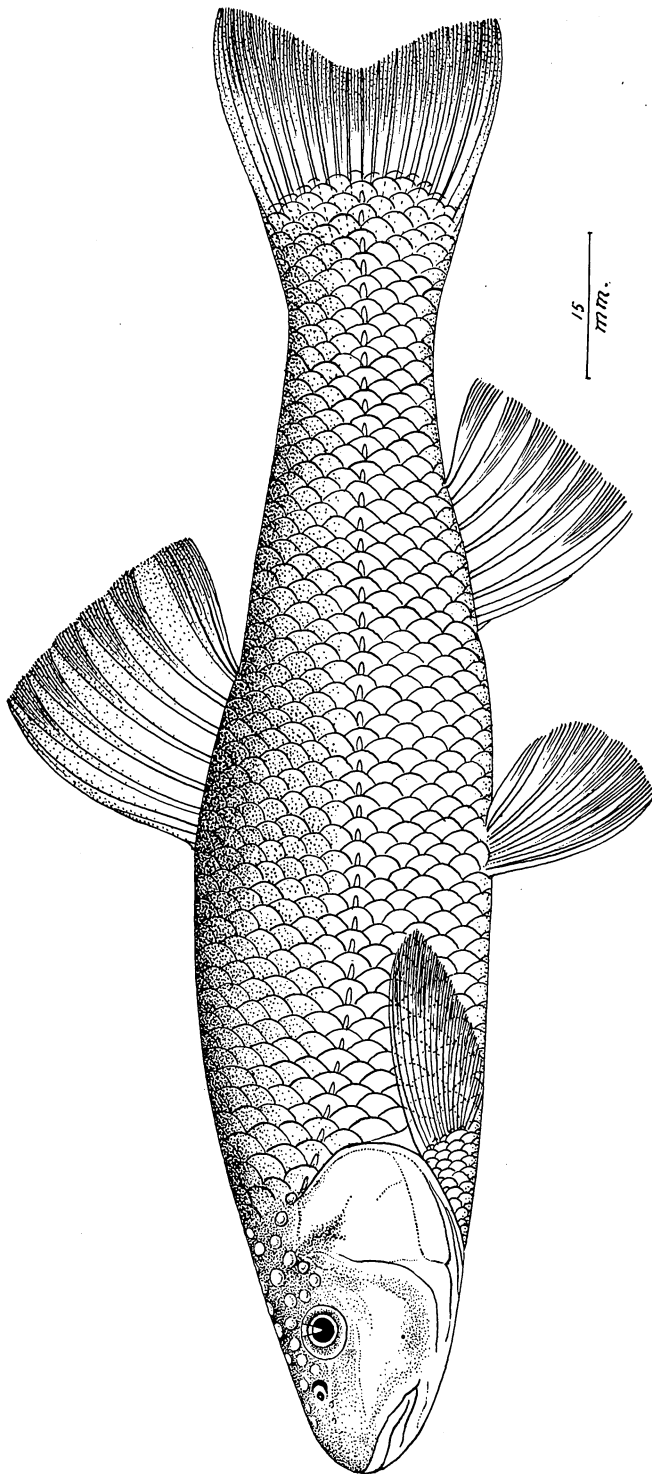
(Cotype of *Phoxinus neogæus* Cope)



(Cotype of *Hybopsis tuditanus* Cope)

HÝBOPSIS KENTUCKIENSIS (RAFINESQUE)

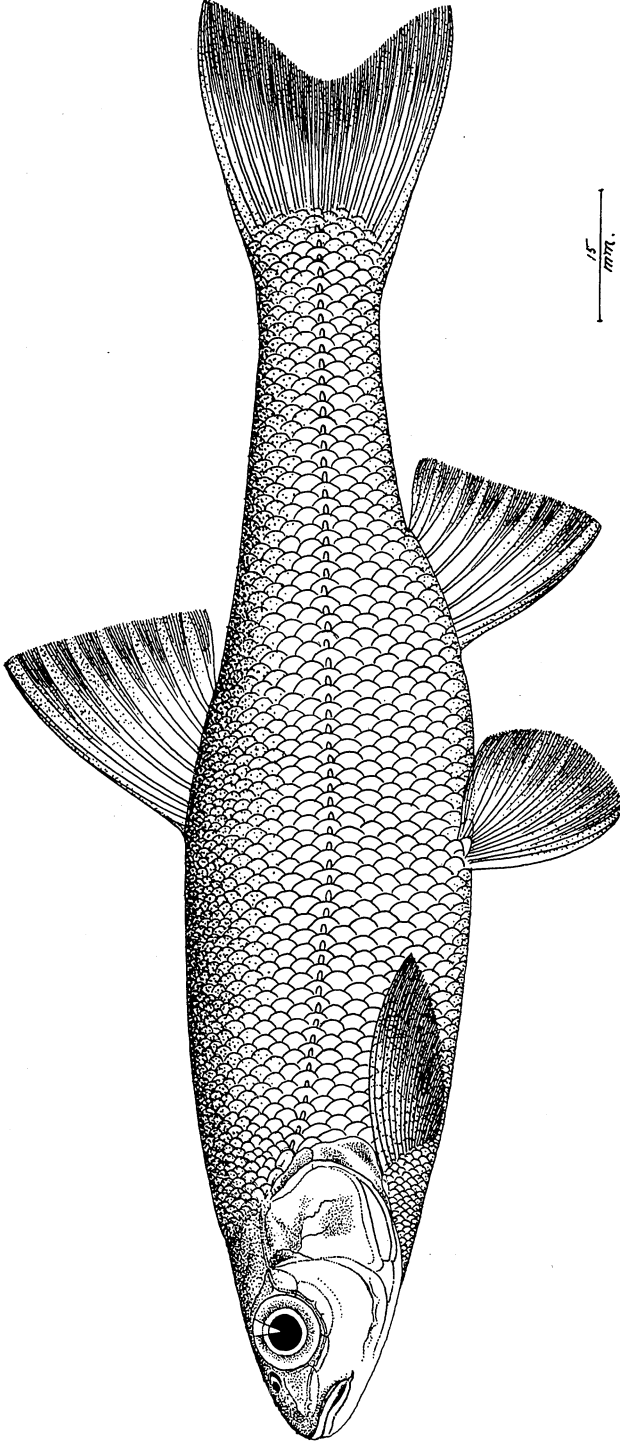
PLATE VIII



(Cotype of *Ceratichthys cyclotis* Cope)

COURSIVUS PLUMBEUS (AGASSIZ)

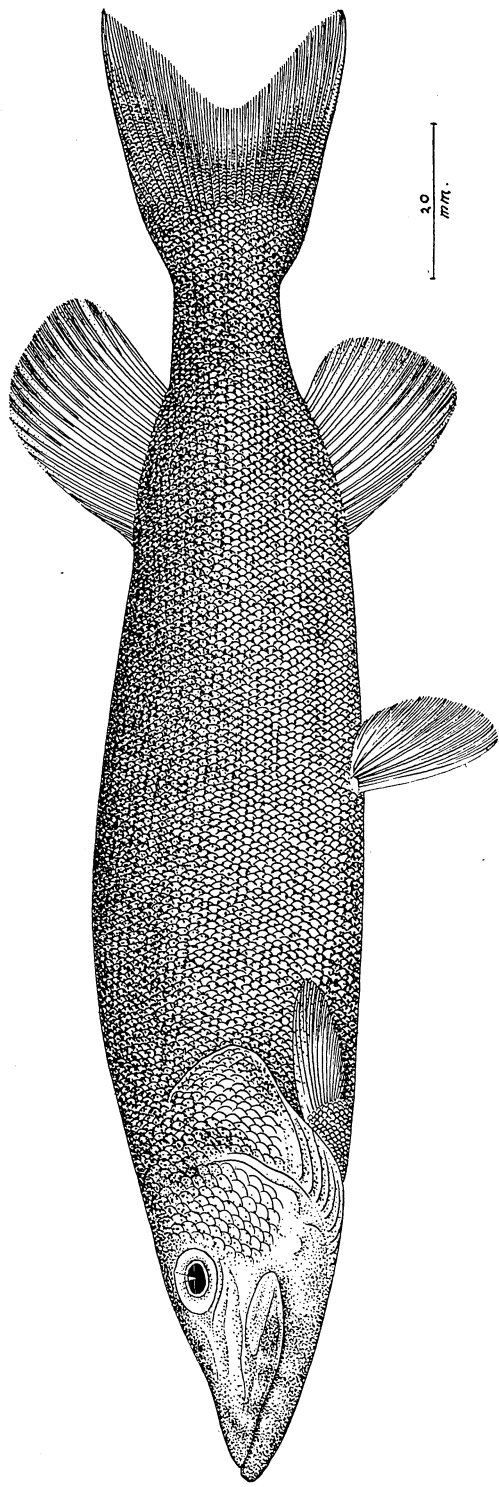
PLATE IX



(Cotype of *Ceratichthys prosthemi* Cope)

ESOX VERMICULATUS VALENCIENNES

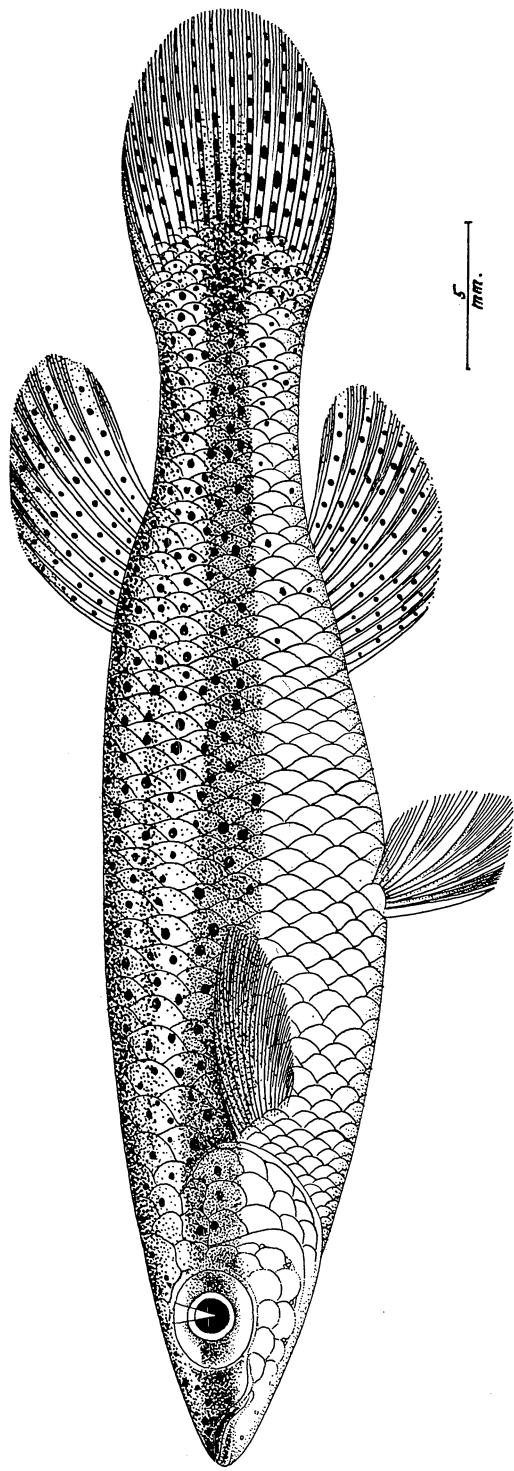
PLATE X



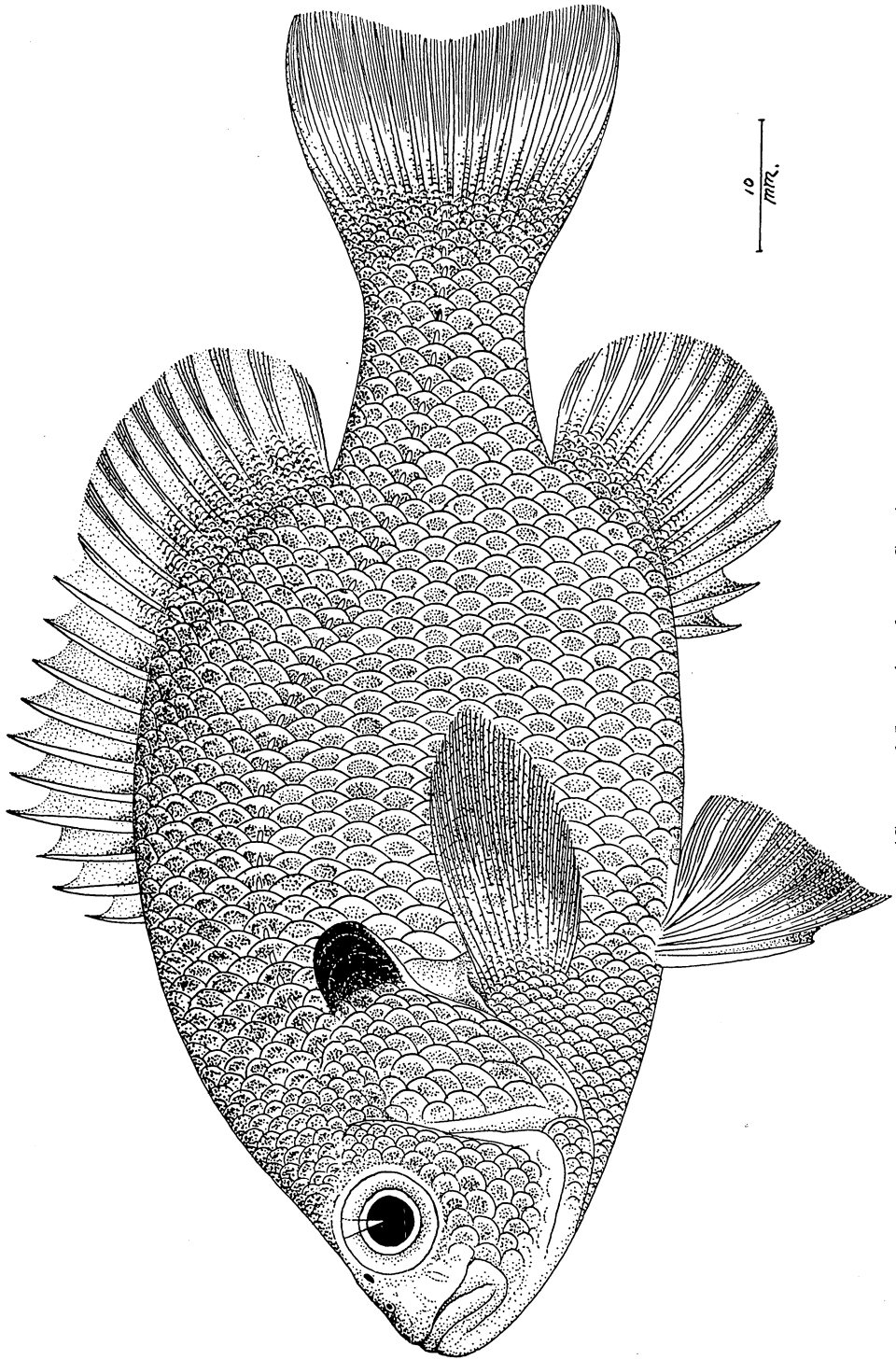
(Cotype of *Lisox cypho* Cope)

FUNDULUS NOTATUS (RAFINESQUE)

PLATE XI



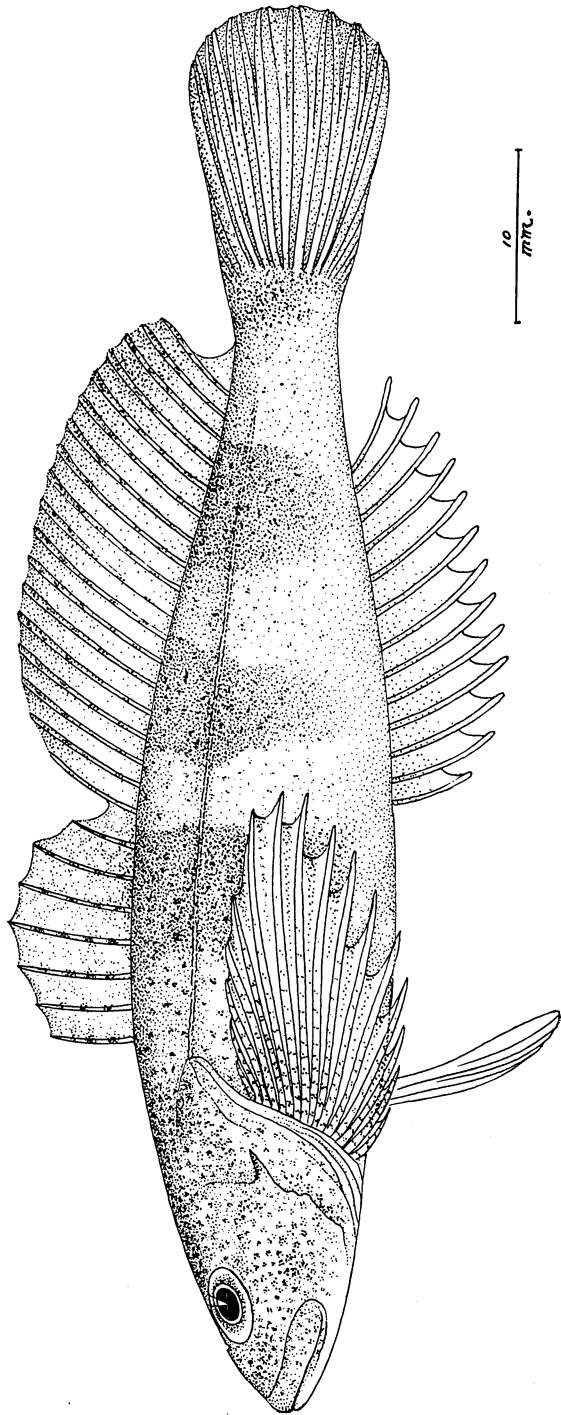
(Type of *Fundulus aureus* Cope)



(Cotype of *Lepomis peltastes* Cope)

COTTUS ICTALOPS (RAFINESQUE)

PLATE XIII



(Dexter, Michigan)



