THE FISHES OF THE ROCKY MOUNTAIN REGION

By T. D. A. Cockerell

For class use, and in connection with my studies of the Rocky Mountain fauna, I have found it necessary to prepare an abstract of our knowledge concerning the fishes of the Rocky Mountain region. The area covered is roughly Montana, Wyoming, Colorado and New Mexico, but the boundaries have been somewhat extended here and there to include certain species. The fossil species are given, although it is anticipated that fresh discoveries will greatly enlarge our knowledge of these in the near future. A good series which the University Expedition of 1907 obtained in the Miocene shales of Florissant is now being studied by Dr. Eastman.

The information given in this paper is compiled from the literature, with the exception of the results of a study of the fishes of Boulder County, based on material in the University of Colorado Museum, mostly collected by Mr. Chancey Juday. By far the greater part is derived from the monumental work of Jordan and Evermann on the *Fishes of North and Middle America* (*Bull. 47, U. S. Nat. Museum*), which is the main source of information for all students of American ichthyology.[1] *American Food and Game Fishes*, by the same authors, but of later date (1902), has also been found exceedingly useful. The basis of our knowledge of Boulder County fishes is the paper by Professor Chancey Juday in *University of Colorado Studies*, Vol. II, p. 113, and *Bull. U. S. Bureau of Fishes*, March 17, 1905. In these papers, unfortunately, the diagnostic characters of the fishes (excepting the new *Leuciscus*) are not given; these I have endeavored to supply. For records of the fossil species, I am primarily indebted to the invaluable catalogue of the *Fossil Vertebrata of North America*, by O. P. Hay (*Bull. 179, U. S. Geol. Survey*, 1901).

I am exceedingly indebted to Dr. B. W. Evermann, who has kindly

[1] The figures illustrating the present paper are derived from this work, with the kind permission of the authorities of the National Museum.

examined the manuscript, and has made a critical examination of a *Notropis* which I had failed to identify.

In the study of geographical distribution, especially as related to past conditions, the value of the evidence afforded by fresh-water fishes can hardly be exaggerated. Thus the following contrast between the genera of the Gila and Rio Grande basins should make those hesitate who believe in the recent depression of the continent in the region of southern New Mexico and Arizona.

CYPRINIDAE

GILA R. BASIN	BOTH	RIO GRANDE BASIN
Gila	**Leuciscus* (also one in Yaqui R. basin, the species of all three basins very close.)	**Campostoma* (also one in Yaqui R. basin)
Tiaroga		**Hybognathus*
Agosia		**Pimephales*
Meda		*Cochlognathus*
		Cliola
		**Notropis*
		**Phenacobius*
		**Rhinichthys* (but also in Great Basin)
		**Hybopsis*

* Boulder County, Colo. (Platte R. Basin).

The case of *Leuciscus*, and the rather similar one of *Rhinichthys*, come under the head of "exceptions which prove the rule;" for the close resemblance (in *Rhinichthys* even identity) of species on the Atlantic and Pacific slopes, taken with the great general diversity, simply shows that these forms must have been transported in some way from one basin to another *since* the separation of the drainage areas. That they are ultra-conservative forms, preserving their characters while all around them has changed in the course of ages, seems scarcely possible.[1]

The general similarity between the fishes of the Rio Grande and Platte basins is as striking as the diversity in the other case.

It is noteworthy that the trout (*Salmo*), which inhabit the waters of

[1] The strong and numerous fish fauna of the Mississippi valley may be thought of as spreading westward, to be checked by the Rocky Mountain chain. How recent this spread may be, and how far it has resulted in the extermination on the Atlantic slope of the mountains of specially western types, remains uncertain; adequate paleontological evidence is wanting. It is proper to remember, however, that characteristic Mississippi valley types of Mollusca occur in the Cretaceous of the Rocky Mountain region.

the high mountains, show closely allied species on the Atlantic and Pacific slopes of the Rocky Mountains.

In the tables and descriptions, D=dorsal fin, A=anal fin; the numbers following these indicate the numbers of rays in the fins, thus D8 means eight rays in the dorsal fin. A roman numeral, as I, II, etc., refers to spines.

The fin-formulae are written as for instance 5–64–7, which "means that there are five rows of scales between the base of the dorsal fin and the lateral line (the scale in the lateral line excluded), 64 oblique transverse series crossing the lateral line, and 7 horizontal scales between the lateral line and the base of the anal or the vent" (Jordan and Evermann).

The teeth-formulae in the Cyprinidae refer to the teeth on the pharyngeal bones. "In most cases a principal row of 4 or 5 larger teeth will be found, in front of which is a set of one or two smaller ones. The two sides are usually, but not always, symmetrical. Thus, 'teeth 2, 4–5, 1' indicates two rows of teeth on each side, on the one side 4 in the principal row and 2 in the lesser; on the other side 5 in the main row 1 in the other" (Jordan and Evermann).

The Orders are given as in Jordan and Evermann; but they seem nearly to correspond with superfamilies in Insecta.

CLASS **PISCES** (The Fishes)

SUBCLASS **SELACHII** (The Sharks and Rays)

ORDER **PLEURACANTHIDES**

The Cladodontidæ are represented by *Cladodus girtyi* Hay, in the Coal Measures of Colorado.

ORDER **ASTEROSPONDYLI** (The Typical Sharks)

FAMILY **Cochliodontidæ**

Orthopleurodus novomexicanus St. John & Worth., and *Poecilodus springeri* St. John & Worth., were described in 1883 from the Subcarboniferous of New Mexico.

Deltodus mercurii Newb., is from the Coal Measures of New Mexico.

FAMILY **Heterodontidæ** (The Bullhead Sharks)

Hybodus polyprion Agassiz, is reported from the Jurassic of Wyoming; it is found also in England.

FAMILY **Galeidæ**

Galeocerdo hartwelli Cope, is from the Niobrara Cretaceous of Colorado.

FAMILY **Lamnidæ** (The Mackerel Sharks)

Corax falcatus Agassiz, is recorded from the Cretaceous of Colorado, and also occurs in Europe. I have collected teeth of this group near Las Vegas, New Mexico, and Colorado Springs, Colorado, but they were not determined.

ORDER **BATOIDEI** (The Rays)

FAMILY **Ptychodontidæ**

Ptychodus whipplei Marcou, occurs in the Niobrara Cretaceous of Colorado and New Mexico. I have collected the characteristic teeth near Las Vegas, N. M.

FAMILY **Dasyatidæ** (The Sting Rays)

Dasyatis radians Marsh. (*Xiphotrygon acutidens* Cope), is found in the Green River beds of Wyoming.

SUBCLASS **HOLOCEPHALI** (The Chimæras)

In this group the skeleton is cartilaginous, and the skin is without scales.

ORDER **CHIMÆRIOIDEI**

FAMILY **Chimæridæ**

Some fossil genera referred here are of very doubtful affinities. *Dictyorhabdus priscus* Walcott, is from the Silurian or Ordovician of Colorado. *Myledaphus bipartitus* Cope, and *Hedronchus sternbergi* Cope, are from the Fort Union Cretaceous of Montana. With regard to the *Myledaphus*, Hatcher remarks that it was founded on isolated teeth, so uncharacteristic as to be of little value for determining genera or species. Such teeth, however, are abundant in the Judith River beds and the Laramie. *Hedronchus* was based on part of a tooth. The modern Chimeridæ are found in the seas of cold regions (Jordan and Evermann).

SUBCLASS **TELEOSTOMI** (The True Fishes)

ORDER **SIRENOIDEI**

FAMILY **Ceratodontidæ**

The genus *Ceratodus* Agassiz, is represented by five fossil species. From the Jurassic are *C. americanus* Knight (Wyoming), *C. guentheri* Marsh (Colorado), and *C. robustus*, Knight (Wyoming). From the Cretaceous, *C. eruciferus* Cope and *C. hieroglyphus* Cope; according to Hatcher these latter occur in the Judith River beds of Montana.

ORDER **RHIPIDISTIA**

FAMILY **Holoptychiidæ**

Eriptychius americanus Walcott, 1892, is from the Lower Silurian or Ordovician of Colorado.

ORDER **SELACHOSTOMI**

FAMILY **Polyodontidæ** (The Paddle Fishes)

Crossopholis magnicaudatus Cope, comes from the Eocene of Wyoming.

ORDER **CHONDROSTEI** (The Sturgeons)[1]

FAMILY **Acipenseridæ**

Length up to five feet; snout broad and depressed, subspatulate (Missouri R. at Fort Benton, Mont., *Henshall*) . . . . . *Scaphirhynchus platorynchus* (Raf.) (Shovel-nose Sturgeon).

[1] *Diphyodus longirostris* Lambe, is based on fragmentary jaws of uncertain affinities, from the Cretaceous of Canada, and also occurring in Montana and Wyoming.

This is the only North American species; others occur in Central Asia.

Dermal structures referred to *Acipenser albertensis* Lambe are found in the Judith R. and Laramie beds of Wyoming, etc.

ORDER **RHOMBOGANOIDEA** (The Gar Pikes)

Numerous species assigned to *Lepidosteus* have been described from the Cretaceous, and Wasatch and Bridger Eocene. *L. aganus* (Cope) and *L. integer* (Cope) are from New Mexico. *L. atrox* Leidy, *L. cyclíferus* (Cope), *L. glaber* Marsh, *L. notabilis* Leidy, *L. occidentalis* Leidy,[1] *L. simplex* Leidy and *L. whitneyi* Marsh are from Wyoming. The living *L. osseus* (L.) occurs in the Rio Grande. Other species live in different parts of North and Central America and one in China.

ORDER **CYCLOGANOIDEA** (The Bowfins)

The single living species (*Amia calva* L.) inhabits the eastern states, and comes as far west as Texas. Two (*A. dictyocephala* Cope and *A. scutata* Cope) are from the Miocene of Colorado. Six (*A. depressa* Marsh, *A. elegans* Leidy, *A. gracilis* Leidy, *A. media* Leidy, *A. newberriana* Marsh, and *A. uintaensis* Leidy) are from the Bridger Eocene of Wyoming.

ORDER **NEMATOGNATHI** (The Catfishes)

FAMILY **Siluridæ**

Rhineastes Cope, is a genus containing one species (*R. pectinatus* Cope) in the Florissant Miocene and five (*R. arcuatus* Cope, *R. calvus* Cope, *R. peltatus* Cope, *R. radulus* Cope, and *R. smithii* Cope) in the Bridger Eocene of Wyoming.

The living species of the Rocky Mountains are as follows:

Adipose fin keel-like, adnate to the back; length up to over a foot; color yellowish brown; fins yellow-edged; anal rays about 16 (Missouri R. in Montana; Wyoming; Platte R.) *Noturus flavus* Raf. (Stone Cat).

Adipose fin with its posterior margin free . . . . . 1.

1. Anal fin very long, its rays 32 to 35 (Rio Grande) *Ictalurus furcatus* (Le Sueur).
   Anal fin with rays 30 or less . . . . . 2.
2. Anal rays 23. . . . . (Pecos R.) . . . . *Ameiurus lupus* (Girard).
   Anal rays 25 to 30; light olivaceous above, the sides pale or silvery, and nearly always with small dark spots (Missouri R., Milk R., and Yellowstone R. in Montana, *Henshall;* Platte R.) . . . . . *Ictalurus punctatus* (Raf.) (Channel Catfish).

Six other forms of *Ameiurus* occur in Texas. *Leptops olivaris* (Raf.), the mud cat, occurs from the Ohio River to the Mexican State of Chihuahua.

ORDER **PLECTOSPONDYLI** (Carplike Fishes)

Teeth well developed in both jaws (in our species) . . . . . *Characinidæ.*

Jaws toothless . . . . . 1.

1. Pharyngeal teeth numerous, pectinate; dorsal fin with 10 or more rays *Catostomidæ.*
   Pharyngeal teeth few; dorsal fin (in ours) short with less than 10 rays . *Cyprinidæ.*

[1] *L. occidentalis* and *haydeni*, of the Judith River beds, were based merely on scales, and are believed to belong to the same species. The supposed differences are: Scale not over 8 mm. long, the enameled surface smooth and shining, *occidentalis* (Leidy); Scale 10 mm. long, the enameled surface with "parallel square lines," *haydeni* (Leidy).

FAMILY **Catostomidæ** (The Suckers)

Amyzon Cope, is represented in the Miocene of Florissant (*A. commune* Cope, *A. fusiforme* Cope, *A. mentale* Cope, *A. pandatum* Cope).

The living Rocky Mountain species are:

Dorsal fin elongate, with 26 or 27 rays (Boulder County, *Juday;* Milk R. and Poplar R. in Montana, *Henshall;* Rio Grande) . . . *Carpiodes velifer* (Raf.) (Quillback).

Dorsal fin with not over 18 rays . . . . . 1.

1. With a sharp-edged hump on the back, not extending forward to the nape; D 12, A 7; scales 16–81–13. (Known from a single specimen, 7 inches long, from the Uncompahgre River at Delta, Colo.) *Xyrauchen uncompahgre* Jordan and Evermann (*X. cypho* Lock.), from the basin of the Colorado and Gila Rivers, has a higher hump, which usually begins at the nape.)
   Normally formed, not humped . . . . . 2.
2. Scales in lateral line less than 50 . . . . . 3.
   Scales in lateral line over 60 . . . . . 4.

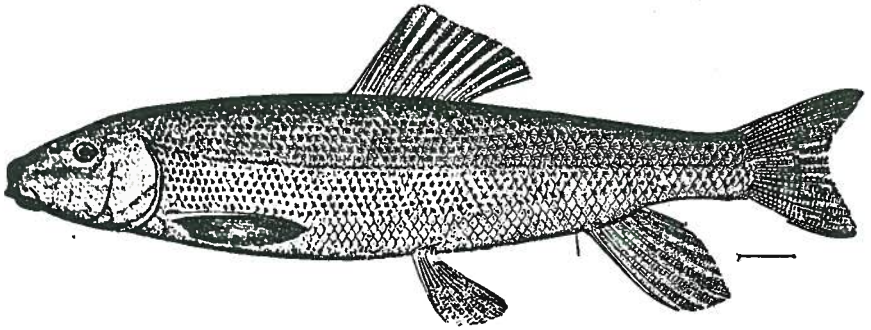

FIG. 1.—*Catostomus commersonii.*

3. Dorsal rays usually 12; dusky above, with usually a black blotch behind the dorsal fin; each scale along the sides with a small, more or less distinct blackish spot at its base, these spots forming interrupted longitudinal lines along the rows of scales; size up to 18 inches long. (Yellowstone R.)
   Minytrema melanops (Raf.) (Spotted Sucker).

Dorsal rays usually 13; olivaceous, sides silvery, lower fins in adult red or orange (Poplar R., Mont., *Henshall*) . . . . . *Moxostoma aureolum* (Le Sueur).

4. Scales in lateral line less than 80; fontanelle between parietal bones present, widely open . . . . . 5.
   Scales in lateral line 80 or more . . . . . 7.
5. Dorsal fin long, of 15 rays; head large (Swan Lake and Post Creek, Montana, *Henshall*) . . . . . *Catostomus macrocheilus* Girard.
   Dorsal fin with 11 to 13 rays . . . . . 6.
6. Upper lip narrow, with usually but 3 to 5 rows of papillæ, but in var. *sucklii* (Girard) with 4 to 6; species of Atlantic slope (Boulder Creek, common; Milk R. and Poplar R., Montana; Twin Lakes, Colo.; Arkansas R. at Pueblo, Colo.)
   Catostomus commersonii (Lacép.).

The western forms are all or mainly var. *sucklii*, which approaches *C. ardens* (Common Sucker.)

Upper lip broader, 4 to 6 rows of papillæ; species of Great Basin (Heart Lake, Yellowstone Park) . . . . . *Catostomus ardens* (Jordan and Gilbert)

7. Species of the Rio Grande basin, Colorado to Chihuahua; scales 80
   Pantosteus plebeius (Baird and Girard).

Species of Wyoming, Montana and Northern Colorado, scales 90 or more 8.

8. Head comparatively large, 4 in length of body; scales 16–90 to 110–14; upper lip with 5 to 8 series of tubercles; lower lip incised to base; dorsal fin with usually 11 rays (Boulder Creek, abundant; Platte River; Montana).
   Catostomus griseus (Girard).

(Var. *lactarius* (Girard) appears to have larger scales, 88 to 90; var. *retropinnis* (Jordan) has fuller lips and a more backward dorsal. (Both these supposed varieties are from Milk River, Montana.)

Head relatively smaller . . . . . 9.

9. Species of Colorado River Basin . . . . . 10.
   Species of Missouri and Columbia R. Basins . . . . . 11.

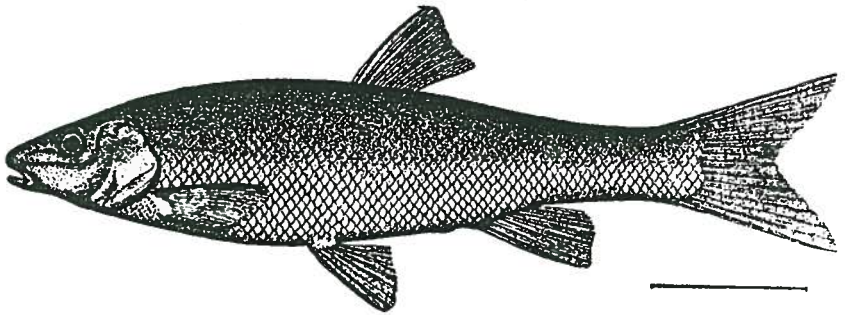

FIG. 2.—*Campostoma anomalum.*

10. Size up to 2 feet; sides and fins largely orange; dorsal rays 11 to 13; scales 17 98 to 105–17 . . . . . *Catostomus latipinnis* (Baird and Girard).
    (Henshall gives *C. discobolus* Cope, from Montana and Wyoming, as distinct.)
    Size up to one foot; dorsal rays 10; scales 16–96 to 105–14 (W. Colorado; Wyoming) . . . . . *Pantosteus delphinus* (Cope).
    (*P. virescens* Cope, reported in error from Pueblo, Colo., is the same.)
11. Length to 2½ feet; head quite long and slender; scales 95 to 114 in lateral line (Montana) . . . . . *Catostomus catostomus* (Forst.) (Long-nosed sucker).
    Length to about one foot; head short, conic; scales 90 to 100 in lateral line (Montana)
    Pantosteus jordani (Evermann).

Another genus of suckers, *Chamistes*, is confined to the Great Basin, with species in Utah, Nevada and Oregon. It has the mouth very large, and terminal instead of inferior as it is in *Catostomus*, and other characters.

FAMILY **Cyprinidæ** (The Carp Family)

The following table separates the genera found in Boulder County, Colorado.

Air-bladder surrounded by many convolutions of the very long alimentary canal; peritoneum black; herbivorous. Sexual differences very great, the males covered with large tubercles in the spring . . . . . *Campostoma.*

Air-bladder above the alimentary canal, as is normal . . . . . 1.

1. Intestinal canal elongate, usually over twice length of body; peritoneum usually black . . . . . 2.
   Intestinal canal short, less than twice length of body . . . . . 4.
2. Dorsal fin inserted posteriorly; scales minute . . . . . *Chrosomus.*
   Dorsal fin nearly median . . . . . 3.
3. First (rudimentary) ray of dorsal slender, firmly attached to the first developed ray as is normal . . . . . *Hybognathus.*

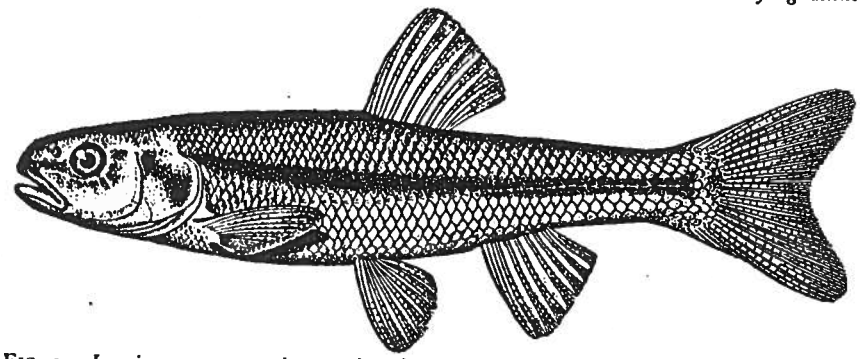

FIG. 3.—*Leuciscus evermanni*, reproduced from the original illustration with permission of the Bureau of Fisheries.

   First (rudimentary) ray of dorsal somewhat enlarged and blunt, connected by membrane with first developed ray . . . . . *Pimephales.*
4. Teeth in the main row 5-5 or 4-5 . . . . . 5.
   Teeth in the main row 4-4, the lesser row often absent . . . . . 6.
5. Maxillary with a minute barbel . . . . . *Semotilus.*
   Maxillary without barbel; teeth strongly hooked . . . . . *Leuciscus.*
6. Maxillary without barbels . . . . . 7.
   Maxillary with a small barbel . . . . . 8.
7. Lower jaw with the lip thin or obsolete; scales large . . . . . *Notropis.*
   Lower jaw with the lip developed as a fleshy lobe on each side . . . *Phenacobius.*
8. Premaxillaries not protractile; scales small . . . . . *Rhinichthys.*
   Premaxillaries protractile . . . . . 9.
9. Teeth 4-4, or 1, 4-4, 1, or 0, the lesser row with never more than one *Hybopsis.*
   Teeth usually 2, 4-4, 2, the lesser row rarely with less than two . . *Couesius.*

The following table for the species is based on the fins and scales:

   Dorsal with spine; DI. 7, A 7; scales 7-43 to 47-6 . . . *Pimephales promelas.*
   Dorsal without spine . . . . . 1.

1. Scales in lateral line over 80 (scales 16-85-10), D 7, A 8 *Chrosomus erythrogaster.*
   Scales in lateral line less than 75 . . . . . 4.
4. Scales above lateral line 11 or 12[1] . . . . . 5.
   Scales above lateral line 9 or less . . . . . 6.
5. D 8, A 7. Scales 11 or 12-63 to 70-9 to 12 . . . *Rhinichthys cataractæ dulcis.*
   D 8, A 8, Scales 12-64 to 72-8 . . . . . *Couesius dissimilis.*
6. Scales in lateral line over 40 . . . . . 7.
   Scales in lateral line less than 40 . . . . . 12.
7. Scales less than 5 below lateral line[1] . . . . . 8.
   Scales 5 or more below lateral line . . . . . 9.
8. D 8, A 9. Scales 6-41-3 . . . . . *Notropis cornutus.*
   D 8, A 7. Scales 6-41-4 . . . . . *Hybopsis kentuckiensis.*
9. D 8, A 7 . . . . . 10.
   Otherwise . . . . . 11.

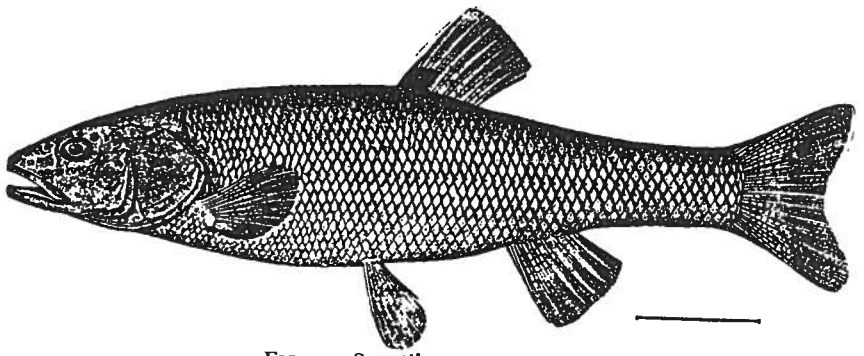

FIG. 4.—*Semotilus atromaculatus.*

10. Scales 7-53-8 . . . . . *Campostoma anomalum.*
    Scales 6-43 to 45-5 . . . . . *Phenacobius scopifer.*
11. D 7, A 8. Scales 9-50 to 60-6 . . . . . *Semotilus atromaculatus.*
    D 8, A 8. Scales 9-47-5 . . . . . *Leuciscus evermanni.*
12. Scales 31 to 33. D 7, A 7 . . . . . *Notropis scylla.*
    Scales 35 or more . . . . . 13.
13. Scales below lateral line 2 (scales 6-35-2); D 7 or 8, A 8 . . *Notropis lutrensis*
    Scales below lateral line 4 . . . . . 14.
14. D 7, A 8; Scales 6-36-4 . . . . . *Notropis piptolepis.*
    D 8, A 7 . . . . . 15.
15. Scales 5-38-4 . . . . . *Hybognathus nuchalis.*
    Scales 5-35-4 . . . . . *Notropis cayuga.*

The above tables are almost entirely derived from the literature. The following one is made from the specimens without reference to the literature:

Two very distinct dark bands on each side; snout blunt; mouth normal; no barbel; scales small, imbedded in the skin; length less than 65 mm.

Chrosomus erythrogaster.

[1] As usually counted; *cf.* preface.

Only one distinct lateral dark band, or none . . . . . 1.

1. Mouth inferior, with rounded corners and thickened lips, sucker-like . 2.
   Mouth ordinary . . . . . 4.
2. Anterior end of dorsal conspicuously before anterior end of ventrals; scales large; snout in lateral view truncate; lips papillose; no barbel . . *Phenacobius scopifer.*
   Anterior end of dorsal level with or posterior to anterior end of ventrals 3.
3. Dorsal without a band; scales small; size rather small; often a small barbel. *Rhinichthys cataractæ dulcis.*
   Dorsal with a black or gray band; scales large; size larger, to over 120 mm.; sides mottled with gray . . . . . *Compostoma anomalum.*
   [Length of ventrals hardly greater than their distance from tips of pectorals *Campostoma anomalum.*
   Length of ventrals much greater than their distance from tips of pectorals *Phenacobius* and *Rhinichthys.*]

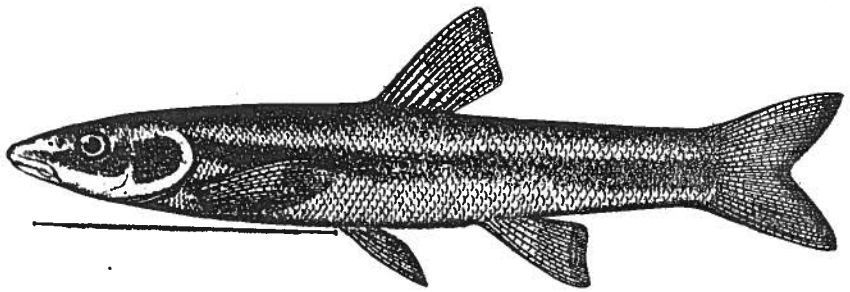

FIG. 5—*Rhinichthys dulcis.*

4. Tips of ventrals reaching base of anal . . . . . 5.
   Tips of ventrals not (usually not nearly) reaching base of anal . . . 7.
5. Body deep . . . . . 6.
   Body not so deep; dorsal with no black spot in front. . . . *Notropis cayuga.*
6. A black spot at base of dorsal; lateral line very incomplete; color above very dark; length about 70 mm. depth about 16 mm. . . . . *Pimephales promelas.*
   No black spot on dorsal . . . . . *Notropis lutrensis.*
   [*Notropis piptolepis* varies, so that tips of ventrals may reach base of anal, or miss it by a short interval.]
7. Scales large, 10 to 12 (8 in *N. scylla*) in oblique line from dorsal to ventrals . . . . . 8.
   Scales moderate, 13 to 14 in oblique line . . . . . *Leuciscus evermanni.*
   Scales small, 15 or more in oblique line . . . . . 10.
8. Eye smaller and snout longer, so that distance from eye to tip of snout is nearly twice diameter of eye . . . . . *Hybopsis kentuckiensis.*
   Eye larger and snout shorter, so that distance from eye to tip of snout is not nearly twice diameter of eye, or is little more than once diameter . . . . 9.
9. In lateral profile, height of eye about equal to, or a trifle less than, distance from eye to nearest point on lower margin of head . . . . . *Notropis cornutus.*

   In lateral profile, height of eye distinctly more than distance from eye to nearest point on lower margin of head . . . . . *Notropis scylla* [also *N. piptolepis*].
   [Here also see *Hybognathus nuchalis*, in which the tips of ventrals are only about 1½ mm. short of base of anal. *Hybopsis kentuckiensis* has a very distinct dark spot at base of caudal; *Notropis cornutus* has a dark lateral band, but no separated spot. The three species of *Notropis* all have a dark dorsal band. *N. zonatus*, var., which also comes in here, has a pale orange dorsal band.]
10. A black spot at base of dorsal fin; middle of head above not tuberculate; barbels absent, or small barbels, away from corner of mouth; corner of mouth about level with front of eye; body not so deep as in *Couesius;* pigmentation of sides consisting of minute gray rings or diffuse spots; scales with about 16 radiating lines, but these hidden by the thick skin . . . . . *Semotilus atromaculatus.*
    No black spot at base of dorsal; middle of head above tuberculate; barbels small but evident, at corner of mouth; corners of mouth strongly anterior to eye; pigmentation of sides consisting of small black dots; scales with 10 or 11 radiating lines, these visible through the thin skin . . . . . *Couesius dissimilis.*

The following table of *Notropis* species is based on the information given by Jordan and Evermann:

Teeth 2, 4–4, 2. D 8, A 9. Length 7 to 8 inches . . . . . *N. cornutus.*
Teeth 4–4 or 1, 4–4, 1. Length 3 inches or less . . . . . 1.

1. Scales not very closely imbricated, not noticeably deeper than long; dorsal inserted nearly over the ventrals; anal short, its rays 7 or 8; no black spot on dorsal fin . . . . . 2.
   Scales deeper than long, more or less closely imbricated on sides of body; scales moderate, 33–38 in lateral line; D 7 or 8, A 8; teeth 4–4; male in life brilliant steel blue, the belly orange-red, anal and caudal blood red, a conspicuous violet crescent behind the shoulders, followed by a crimson crescent; female plain greenish. Length 2¾ inches . . . . . *N. lutrensis.*
2. Teeth 2-rowed (1, 4–4, 1). Small slender species; D 7, A 8; olivaceous, silvery below; a broad silvery lateral band, with dark specks; sides of head with black specks; a dark dorsal band. Length 3 inches . . . . . *N. piptolepis.*
   Teeth 1-rowed (4–4) . . . . . 3.
3. Lateral line wanting on some scales; eye large; scales above dark-edged, the outlines very sharply defined; a black stripe through snout and eye; a dusky lateral shade and a small caudal spot. Length 2½ inches . . . . . *N. cayuga.*
   Lateral line complete; D 7, A 7. Color pale, back greenish, side with a silvery band, no spots on fins; a dusky shade on each side of dorsal and before it; some dark spots on snout. Length 2¾ inches . . . . . *N. scylla.*

The following is based on specimens, without reference to the literature:

Body deep, its depth nearly or quite equal to distance between base of anal and hind edge of insertion of pectorals; base of dorsal not before base of ventrals. *N. lutrensis.*
Body not so deep, its depth not nearly equal to distance between base of anal and hind edge of insertion of pectorals . . . . . 1.

1. Base of dorsal distinctly (1 or 2 scale rows) before base of ventrals; length over 80 mm. *Hybognathus nuchalis.*

Base of dorsal level with or posterior to base of ventrals . . . . 2.

2. A very distinct black spot at base of caudal; size rather large, 75 mm. *N. scylla.*
(Still larger, but with no spot at base of caudal . . . . . *N. cornutus.*)
No distinct spot at base of caudal; our specimens smaller, 70 mm. or less 3.

3. A very distinct black band from snout to eye, and continuing behind eye *N. cayuga.*
No such black band, or at most vestiges of it, behind eye only . . . 4.

4. A strong black dorsal band, on a grayish-yellow ground;[1] the scales dusky-margined by copious dots; sides more or less silvery; broad, breadth 9 or 10 mm. in fish about 70 mm. long . . . . . *N. piptolepis* (see here also *cornutus* when young).
A pale orange dorsal band on a bright straw-yellow ground,[1] the scales minutely black-dotted, but not appearing dusky-margined; sides strongly silvery; lateral line complete; a grayish lateral stripe; dorsal and caudal fins yellowish; dorsal black speckled; D 8, A 9 (not counting rudimentary anterior ray); a crest above each nostril; chin black-speckled; scales 8 or 9–38–5, 12 before dorsal in lateral line; form narrow, breadth 6 mm. in fish about 65 mm. long. (Boulder Creek, Boulder, Nov. 1907.) . . . . . *Notropis zonatus* (Agassiz), var.[2]

The recorded Rocky Mountain Cyprinidæ are as follows:

Campostoma anomalum Raf. Colo., Wyo.

Chrosomus erythrogaster Raf. Colo.

Hybognathus nuchalis Agass. Colo., Mont.

H. argyritis Girard. Milk R. Mouth wider than in *nuchalis;* may intergrade.

H. (*Dionda*) *serena* Girard. Pecos R. D 8, A 8. Scales 5–32 to 34–3.

H. (*Dionda*) *episcopa* Girard. Pecos R. D 8, A 8. Scales 9–37 to 41–4.
The name is in punning allusion to Capt. Pope, its discoverer.

H. (*Dionda*) *nubila* Forbes. Wyo. D 8, A 9. A dark lateral band.

H. (*Dionda*) *amara* Girard. Rio Grande (doubtful species). D 8, A 7. No dark lateral band.

Pimephales promelas Raf. Colo., Mont., Rio Grande, Yellowstone R.

P. promelas maculosus Girard. Arkansas R. at Pueblo. Lateral line better developed, the pores wanting on less than half of the scales.

P. promelas confertus Girard. Pecos R. drainage in Texas, etc. Lateral line complete, and male differently colored.

Mylocheilus caurinus Richardson. Flathead Lake. A species of the northwest Pacific region, just reaching Montana. Devours eggs of salmon.

Semotilus atromaculatus Mitchill. Colo., Wyo.

Ptychocheilus oregonensis Richardson. Missoula, Mont. Species of Pacific slope.

Ptychocheilus lucius Girard. Delta, Colo. Species of Colorado Basin. The largest of American Cyprinidæ, reaching a weight of 80 lbs. Body slender, elongate, with long, slender depressed head. D 9, A 9.

[1] In alcohol.

[2] This fish was sent to Dr. Evermann, who kindly reports that it is very close to *zonatus*, and probably that species, although it differs slightly in some of its characters. *N. zonatus* is a species of mountain streams in the Ozark region of Missouri and Arkansas, and the discovery of a very closely allied or identical fish in Colorado is of much interest. Typical *zonatus* is said to have scales 6–42–4. Dr. Evermann has added several characters to the diagnosis of our fish. He finds: head 4; eye about 3½; teeth 2, 4–4, 2; scales 8–43–4, 24 before the dorsal. In my count, I made out fewer scales in the lateral line, but I counted only the pore-bearing ones.

Gila robusta Baird and Girard. Delta, Colo.; Zuni R. Species of Colorado and Gila Basins. Length 16 inches.

Gila elegans Baird and Girard. Gila R. and Zuni R. Length 12 inches.

(*G. nacrea* Cope, from Fort Bridger, Wyo., is *G. robusta* or young *G. elegans.*)

Leuciscus evermanni Juday. Only known from three examples obtained by Professor Juday in Boulder Creek. One of these is in the University of Colorado Museum.

L. lineatus Girard. Wyo. Species of Great Basin and Snake R. Basin. D 9, A 8. Scales in lateral line 53 to 63.

L. nigrescens Girard. San Luis Park; Sangre de Cristo Pass, Colo.; Las Vegas and near Ft. Wingate, N. M. Species of Rio Grande Basin. D 8, A 8. Scales in lateral line 60 to 67.

L. aliciæ Jouy. Evanston, Wyo. Species of Great Basin of Utah. D 8, A 8. Scales in lateral line 80.

L. hydrophlox Cope. Heart Lake, Wyo. Species of Great Basin. D 9, A 10 to 13. Scales 12–58–5. Length 3 to 5 inches.

L. balteatus Richardson. Silver Bow, Mont. Species of Columbia Basin. D 10, A 11 to 22, usually 16. Scales 13–55 to 63–6.

Notropis[1] (*Chriope*) *cayuga* Meek. Colo.

N. (*Alburnops*) *scylla* Cope., Colo., Mont. The type locality is Red Cloud Creek, a tributary of the Platte R.

N. (*Hudsonius*) *gilberti* Jordan and Meek. Platte R. Very close to *piptolepis*, but D 8, A 9; scales 5–35–4; 17 scales before dorsal; light olive, sides with dusky streaks and dark specks.

N. (*Hudsonius*) *piptolepis* Cope. Boulder County; N. Platte R.

N. (*Hudsonius*) *simus* Cope. Rio Grande at San Ildefonso, N. M. D 8, A 9. Scales 8–35–4, 22 series in front of dorsal. Robust, entirely silvery.

N. (*Moniana*) *lutrensis* Baird and Girard. Boulder Co., Colo.; Rio Grande at San Ildefonso, N. M.

N. (*Moniana*) *proserpina* Girard. Rio Grande Region, New Mexico. D 7, A 7. Scales 6–35–3, 14 before dorsal. Brownish above, paler below, but no silvery lateral band; a metallic band of dark points from upper edge of preopercle to upper edge of caudal. Length 2 inches.

N. (*Cyprinella*) *macrostomus* Girard. Roswell, New Mexico. D 8, A 9. Scales in lateral line 36. Brownish above, cheeks and sides bright silvery.

N. (*Luxilus*) *cornutus* Mitchill. Colo.

N. (*Orcella*) *orca* Woolman. Rio Grande at El Paso, Texas. D 7, A 8. Scales 8–42–4. Body plump, top of head unusually high and transversely rounded.

N. atherinoides Raf. Mont. D 8, A 11. Scales 5–38–3. Translucent green above, sides bright silvery. Length 4 to 6 inches.

N. dilectus Girard. Rio Grande at San Ildefonso, N. M. D 8, A 11. Scales 7–38–3. Colors very pale; silvery, snout and bases of fins rosy; a row of black dots above base of anal.

Phenacobius scopifer Cope. Boulder Co., Colo.; Rio Grande.

[1] JORDAN and EVERMANN remark that no *Notropis* is found in Utah. No species is recorded from the Pacific slope in Colorado.

Rhinichthys cataractæ dulcis Girard. Boulder Co., Colo., abundant in Boulder Creek; Las Vegas, N. M.; tributaries of Rio Grande; eastern Wyo. and Mont., also in the Great Basin.

Agosia yarrowi Jordan and Evermann. Colorado R. Basin. Gunnison R. at Gunnison. Genus scarcely different from *Rhinichthys*. D 7, A 7. Scales small, about 16–78–13. Barbel small but distinct. Sides with two ill-defined dark lateral bands.

Hybopsis (*Erimystax*) *æstivalis* Girard. Rio Grande at San Ildefonso, N. M.

Hybopsis (*Erimystax*) *gelidus* Girard. Wyo., Mont.

Hybopsis (*Erimystax*) *montanus* Meek. Upper Missouri, Mont.

Hybopsis storerianus Kirtland. Eastern Wyo.

H. (*Nocomis*) *kentuckiensis* Raf. Colo., Wyo.

The following table is from that of Jordan and Evermann:

Species of large size, not silvery, the mouth larger, nearly terminal *H. kentuckiensis*.
Species of moderate or small size except *storerianus*, the mouth inferior, horizontal; preorbital broad, silvery . . . . . 1.

1. Large up to 10 inches; sides bright silvery . . . . . *H. storerianus*.
   Small, less than 3 inches . . . . . 2.
2. Back and sides pale, not dusted with dark dots . . . . . *H. montanus*.
   Back and sides sprinkled with dark dots . . . . . 3.
3. Lower lobe of caudal pale; snout moderate . . . . . *H. æstivalis*.
   Lower lobe of caudal black in life; snout very long . . . . . *H. gelidus*.

Couesius squamilentus Cope. Henry Fork of Green R., Wyo. Species of Colorado Basin. Scales 17–66–14 D. 8, A. 7

C. dissimilis Girard. Colo., Mont.

Platygobio physignathus Cope. Pueblo, Colo., where it is said to be the most common fish. Barbel distinct; D 8, A 8; scales 6–48–5, 20 before dorsal. Olivaceous above, white below, a plumbeous lateral band; fins plain. Length 6 inches.

P. gracilis Richardson. Milk R., Yellowstone R., etc. Length 12 inches. No dark lateral band.

Plagopterus argentissimus Cope. San Luis Valley, Colo.[1] D II. 7, A 10. Body entirely scaleless; color clear silvery, back dusky. Length 2½ inches.

The domesticated carp and goldfish have the dorsal fin elongate, and the dorsal and anal fins each preceded by a serrated spine. The carp (*Cyprinus carpio* L.) has four long barbels; the goldfish (*Carassius auratus* L.) has none. Both are of Old World origin.

Family Characinidæ

"A very large family of some 55 genera and 300 species, inhabiting the fresh waters of South America and Africa, where they take the place of the Salmonidæ and Cyprinidæ of the Northern Hemisphere" (Jordan and Evermann). Only one species occurs in the United States, namely *Tetragonopterus argentatus* (Baird and Girard), which I have obtained from North Spring River, Roswell, New Mexico.

[1] Jordan and Evermann describe this fish as inhabiting the Colorado basin in western Colorado. In this case the assigned type locality, the San Luis valley, may be doubtful, as this is in the upper Rio Grande basin. The fish is related to Pacific slope genera, not to anything in the Rio Grande. According to Gilbert it occurs at Fort Yuma.

Order APODES (The Eels)

Family Anguillidæ

The common eel, *Anguilla chrysypa* Raf., is found in the Rio Grande. Girard separated the Rio Grande fish as a distinct species, *A. tyrannus*, but Jordan and Evermann treat it as a synonym.

Order ISOSPONDYLI

Family Chirocentridæ

Portheus thaumas Cope, is from the Niobrara Cretaceous of Kansas, and perhaps of Colorado.

Family Hiodontidæ (The Moon-Eyes)

Body oblong, much compressed, covered with brilliantly silvery scales. The moon-eye, *Hiodon alosoides* (Raf.), and the toothed herring, *H. tergisus* Le Sueur, have been found in Montana (*Henshall*). *H. alosoides* has the dorsal with 9 developed rays, *H. tergisus* has it with 12.

Family Clupeidæ (The Herrings)

Six species occur in the Green River shales of Wyoming. These are *Diplomystus analis* Cope, *D. dentatus* Cope, *D. pectorosus* Cope, *D. theta* Cope, *Knightia alta* (Leidy), *K. eocæna* Jordan. The last is *Clupea humilis* Leidy, and *C. pusilla* Cope, both names preoccupied. Dr. Jordan justly objects to Dr. Dollo's proposal to rename *Diplomystus* Cope, calling it *Copeichthys* Dollo.

The genera of Green R. Clupeids are thus separated:

Dorsal scutes transverse, with pectinate borders, a median tooth especially prominent *Diplomystus* Cope
Dorsal scutes not wider than long, with only a single median tooth, at the end of a longitudinal carina . . . . . *Knightia* Jordan

The scales of *Knightia* are much larger than those of *Diplomystus*, about 35 in lateral line (over 60 in *Diplomystus*). (See Jordan, *Univ. of Calif. Publ., Geology*, Vol. V, No. 7, p. 136.)

The Museum of the University of Colorado contains good material of *D. analis*. There is also a well-preserved example of *Knightia eocæna*.

Family Salmonidæ (Salmon and Trout)

Jaws toothless or nearly so; scales large . . . . . 1.
Dentition strong and complete . . . . . 3.

1. Olivaceous above, sides white, but not silvery; scales 8–74–9 (introduced in Flathead Lake, Montana) . . . . . *Coregonus clupeiformis* (Mitchill) (Whitefish)
   Bluish above, sides silvery . . . . . 2.
2. Scales in lateral line 83 to 87; length about a foot. (Great Basin and Pacific Slope, reaching Montana) . . . . . *Coregonus williamsoni* Girard (Williamson Whitefish)
   Scales in lateral line 90; slenderer than the last, with lower fins. (Upper Missouri Basin in Montana) . . . . . *Coregonus cismontanus* (Jordan). Henshall gives only *cismontanus* from Montana, calling it the Rocky Mountain Whitefish. However, *Coregonus couesii* Milner, which Jordan and Evermann refer to *williamsoni*, was from Chief Mountain Lake, Montana.

3. Black spotted species; vomer flat . . . . . 4.
   Spotted with red or gray; vomer boat-shaped . . . . . 10.
4. Scales typically large, in 120 to 130 cross series; but varying from 115 to 180; usually no red on throat; mouth small; size moderate (Montana, introduced) *S. irideus* Gibbons.
   Scales moderate, 130 to 180 cross series; no red on throat; mouth moderate; size very large (Montana, introduced) . . . . . *S. gairdneri* Richardson.
   Scales always small usually in about 160 (150 to 200) cross series; nearly always a large deep red or scarlet dash on each side concealed below inner edge of each dentary bone; mouth large (native species) . . . . . 5.
5. Black spots almost as numerous on head as on posterior part of body . 6.
   Black spots mainly on posterior part of body . . . . . 7.
6. Black spots encroaching somewhat on belly (both slopes of the Rocky Mts. in Montana, *Henshall*) . . . . . *S. clarkii* Richardson.
   Black spots not encroaching on belly (headwaters of Yellowstone Falls of Missouri R.) *S. lewisi* Girard.[1]

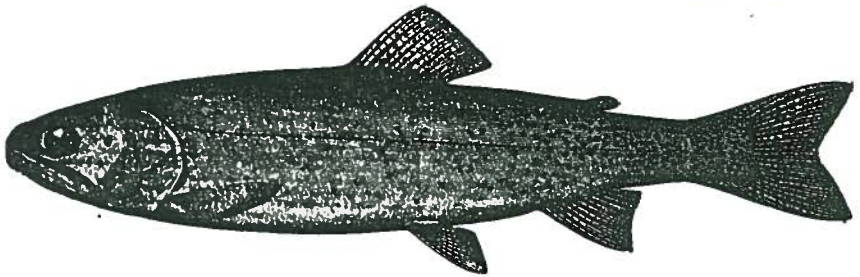

FIG. 6.—*Salmo macdonaldi.*

7. Scales not very small, about 160 in lateral line; spots of moderate size (Species of Rio Grande Basin, Colorado and New Mexico) . . . . . *S. spilurus* Cope.
   Scales very small, about 180 in lateral line . . . . . 8.
8. Spots rather large, lower fins distinctly red, rarely orange . . . . 9.
   Spots all small; lower fins bright yellow; a yellow lateral shade (Twin Lakes, Colo.) *S. macdonaldi* Jordan and Evermann.[2]
9. Spots very numerous; a red lateral band (Colorado Basin; western slope in Colo.) *S. pleuriticus* Cope.
   Spots few and large, chiefly on the tail (Arkansas and Platte Rivers; Boulder Creek. Boulder, Nov. 1907, *DeVoss and Perkins*) . . . . . *S. stomias* Cope.
   (*Salmo fario* L., the European Brown Trout, has been introduced in Montana.)
10. Vomer with a raised crest; spotted with gray, without bright colors; D 11, A 11 (Montana) . . . . . *Cristivomer namaycush* Walbaum,
    Vomer without raised crest; red-spotted, lower fins with bright edgings. 11.

[1] "One of the present writers has caught them in the very act of going over Two-Ocean Pass from Pacific into Atlantic drainage" (JORDAN AND EVERMANN, *American Food and Game Fishes*, p. 179).

[2] A small Crustacean, *Diaptomus judayi* Marsh. is also confined to Twin Lakes, so far as is known.

11. Back unspotted, but strongly marbled with dark olive or black; dorsal and caudal fins mottled (Allen's Park, Boulder Co., Colo., September 6, 1907. *S. A. Rohwer*, doubtless introduced; Montana, introduced) . . . *Salvelinus fontinalis* Mitchill. (Eastern Brook Trout.)
    Back with red spots, like those on sides, but smaller and usually paler; no dark marbling above (West Montana, native) . . . . . *Salvelinus parkei* Suckley. (*malma* auctt., not Walbaum) (Dolly Varden Trout).

FAMILY Gonorhynchidæ

Notogoneus osculus Cope, is from the Green River shales.

FAMILY Osteoglossidæ

Phareodus acutus Leidy, is from the Bridger Eocene of Wyoming. *P. æquipinnis* (Cope), *P. encaustus* (Cope), and *P. testis* (Cope), are from the Green River beds of Wyoming. *Dapedoglossus* Cope, is the same genus.

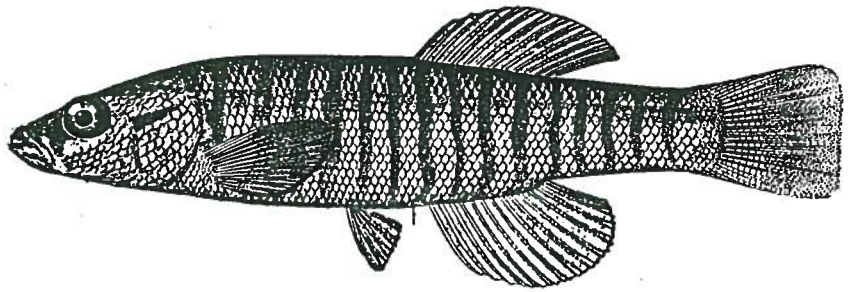

FIG. 7.—*Fundulus zebrinus.*

FAMILY Thymallidæ (The Graylings)

The Montana Grayling, *Thymallus ontariensis montanus* (Milner), occurs in the tributaries of the Missouri River in Montana. Dr. Henshall, following Milner, treats this as a distinct species, *T. montanus*. It is in fact separated by a long distance from the habitat of *T. ontariensis* in Michigan, and should logically stand as a species, but its distinctive characters are few. Jordan and Evermann say: "Entirely similar to the Michigan grayling, but the dorsal a little smaller."

ORDER HAPLOMI

FAMILY Luciidæ (The Pikes)

Ischyrhiza antiqua Leidy, is from the Fox Hills Cretaceous of New Mexico.

FAMILY Pœciliidæ (The Killfishes)

Sides with many dark crossbars; dorsal rays 14 or 15 (Boulder County, *Juday;* Pueblo, Colo.; New Mexico) . . . . . *Fundulus zebrinus* Jordan and Gilbert
Brownish, finely dotted; lips, top of head, and line along middle of back dark; dorsal rays 11 (Wyoming) . . . . . *F. lineatus* Garman
Olive gray, scales with ochre borders; fins yellow, edged with red; dorsal rays 10 (Boulder County, *Juday;* Denver, Colo.; Arkansas R.) . . . . *F. floripinnis*, Cope

Order HEMIBRANCHII

Family Gasterosteidæ (The Sticklebacks)

The Brook Stickleback, *Eucalia inconstans* (Kirtland), is reported by Henshall from Poplar R., Montana. It has 4 or 5 dorsal spines.

Order ACANTHOPTERI (The Spiny-Rayed Fishes)

Family Aphredoderidæ (The Pirate Perches)

Dorsal fin single, with few small spines. Vent anterior, its position varying with age, from just behind the ventral fins in the young, to below the preopercle in the adult. One genus and species among living fishes, confined to the eastern United States. The group is so distinct that Jordan and Evermann place it in a distinct suborder, Xenarchi.

No less than four genera of these fishes have been described by Cope from the Rocky Mountain Tertiaries. Jordan and Evermann remark that these fossil genera "seem to stand between *Aphredoderus* and *Elassoma*, which seem to be near relatives on the one hand, as *Percopsis* is on the other."

The fossils are:

Trichophanes foliarum Cope, and *T. copei*, Osborn, Scott and Speir, Miocene shales of Florissant, Colorado.

Amphiplaga brachyptera Cope, *Asineops pauciradiatus* Cope, *A. squamifrons* Cope, *Erismatopterus endlichii* Cope, *E. levatus* Cope, and *E. rickseckeri* Cope, all from the Green River beds of Wyoming.

Family Mugilidæ (The Mullets)

Two short dorsal fins, well separated, the anterior with four stiff spines, of which the last is much the shortest.

Pelecorapis berycinus Cope, is from the Pierre Cretaceous of Montana.

Syllæmus latifrons Cope, is from the Benton Cretaceous, doubtfully of New Mexico.

Family Centrarchidæ (The Sunfishes)

Body more or less shortened and compressed. Dorsal fins confluent.

Jordan and Evermann say: "fresh-water fishes of North America; genera 12; species about 30, forming one of the most characteristic features of our fish fauna." They appear to be very few in the vicinity of the Rocky Mountains, however.

Dorsal fin scarcely longer than anal; silvery olive, mottled with clear olive green (Boulder County, introduced: *Juday*) . . . . . *Pomoxis sparoides* (Lacép.) (Calico Bass).

Dorsal fin much larger than the anal . . . . . 1.

1. Body comparatively elongate, the depth of adult about one-third the length; dorsal fin low, deeply emarginate, with 10 spines . . . . . 2.
   Body comparatively short and deep; dorsal fin not deeply emarginate 3.
2. Mouth moderate; young more or less barred or spotted, never with a black lateral band (introduced in Montana) . . . . . *Micropterus dolomieu* Lacép. (Small-mouthed Black Bass).
   Mouth large; young with a blackish lateral band (introduced in Boulder Co., Colo., and Montana) . . . . . *Micropterus salmoides* Lacép. (Large-mouthed Black Bass).

3. Dorsal spines strong and high, the longest usually longer than snout and eye; olive green, adults dark; sides with undulating greenish bars, becoming obsolete in adult (Rio Grande) . . . . . *Lepomis pallidus* (Mitchill) (Blue-gill).
   Dorsal spines low, the longest little longer than snout . . . . . 4.
4. Brilliant blue and orange, the back chiefly blue, the belly entirely orange; cheeks orange with bright blue stripes; length 8 inches. (Rio Grande) *Lepomis megalotis* (Raf.) (Long-eared Sunfish).

   The prevailing shade green, with a strong brassy luster on sides, which becomes nearly yellow below; each scale usually with a blue spot. (Boulder County, *Juday*, Rio Grande) . . . . . *Apomotis cyanellus* (Raf.) (Blue-spotted sunfish).

   Spirit specimens of *Apomotis cyanellus* are a sort of bluish-gray or pale plumbeous, with a faint lattice-marking, and scattered small dark spots. The fish is quite unlike any other native in Boulder County.

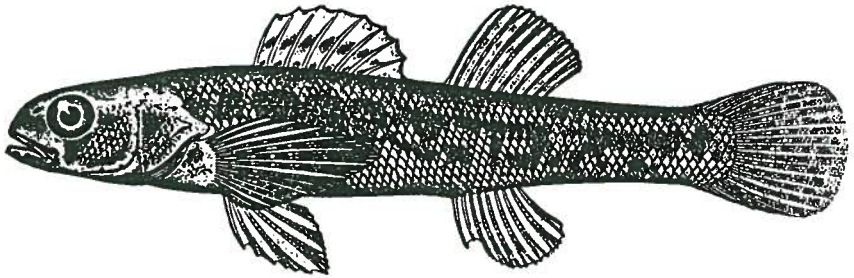

Fig. 8.—*Etheostoma iowæ.*

Family Percidæ (Perch Family)

Mioplosus Cope, is a genus of the Green River Shales of Wyoming, with the following species: *M. abbreviatus* Cope, *M. beani* Cope, *M. labracoides* Cope, *M. longus* Cope, *M. sauvageanus* Cope.

The living forms are as follows:

Large fishes, with preopercle serrate; mouth large, terminal . . . . . 1.
Small fishes, preopercle entire or nearly so . . . . . 2.

1. Canine teeth none; body oblong; ventral fins near together; back dark olivaceous, sides golden yellow, with 6 or 8 dark bars (Montana, introduced) *Perca flavescens* Mitchill (Yellow Perch).
   Canine teeth on jaws and palatines; body elongate, head with a snakelike aspect (Upper Missouri R.) . . . . . *Stizostedion canadense boreum* Girard (Northern Pike-Perch).
2. Only one anal spine (A I, 7 to 9); length of fish about or nearly 70 mm.; scales larger than in *E. iowæ*, about 1⅜ mm. across; eye about 1⅞ mm. from mouth; dorsal fin touching, or slightly separated; parietal region of head concave. (Boulder Co., *Juday*) *Boleosoma nigrum* Raf.
   Two anal spines; anal rays 6 to 8 . . . . . 3.
3. Humeral region with a distinct black process or scale; scales 46 to 55 in lateral line; snout much shorter than eye (Cañon City, Colo.) . *Etheostoma cragini* Gilbert.
   Humeral region with at most a faint dark spot . . . . . 4.

4. Head entirely scaleless; scales 6–48 to 54–8; olivaceous, with dark blue bars. (Dimmit Lake, near Roswell, N. M., *Cockerell*). *Etheostoma lepidum* Baird and Girard.
Head partially scaly; scales 5–55 to 63–11; length about 55 mm.; scales a little over 1 mm. across; eye about ⅓ mm. from mouth; dorsal fins distinctly separated. (Boulder Creek, Boulder, Nov. 1907.) . . . . *Etheostoma iowæ* Jordan and Meek.[1]

FAMILY **Pomacentridæ** (The Demoiselles)

Fishes of tropical seas. Nostril single on each side, nearly round, a character "shared with the *Cichlidæ* only, from ancestors of which group the *Pomacentridæ* are probably descended."

Priscacara Cope is a genus of the Green River shales in Wyoming, with these species: *P. clivosa* Cope, *P. cypha* Cope, *P. hypsacantha* Cope, *P. liops* Cope, *P. oxyprion* Cope, *P. pealei* Cope, *P. serrata* Cope. A good example of *P. liops* (with, however, 14 caudal vertebræ instead of 13) is in the Museum of the University of Colorado (Maxwell collection).

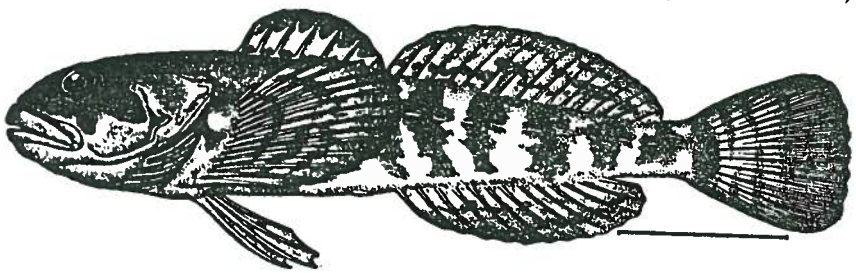

FIG. 9.—*Cottus punctulatus.*

ORDER **PLECTOGNATHI**

FAMILY **Cottidæ** (The Sculpins)

Caudal peduncle very slender, its least depth not much greater than diameter of eye; body and head profusely speckled (Green River, Wyoming). *Cottus punctulatus* Gill.
Caudal peduncle deep, its least depth equal to length of snout; back and sides less distinctly speckled . . . . . 1.

1. Head blunt, low, rounded anteriorly; body with vague dark clouds and specks. (Colorado, New Mexico, Wyo., Mont.)
Cottus semiscaber Cope (Rocky Mountain Bullhead).
Head less rounded, with a median depression; body usually with broad, oblique, dark bars; small and slender; the spinous dorsal very low. (Swan R., Montana, *Linton*, possibly in error for *semiscaber*) . . . . *Cottus ictalops bairdii* Girard.

FAMILY **Gadidæ** (Codfish Family)

Scales small, cycloid; mouth large; chin with a barbel. Marine, except *Lota*. Anal fin not notched; length of fish 2 feet; barbel longer than eye (Montana).
Lota maculosa Le Sueur (Burbot or Ling).

[1] *E. iowæ* seemed far out of range, but I sent a speciman to Dr. Evermann, and he reports that it agrees well with typical specimens from Iowa and Nebraska.

THE SANDSTONE OF FOSSIL RIDGE IN NORTHERN COLORADO AND ITS FAUNA

BY JUNIUS HENDERSON

Fossil Ridge is a low ridge of sandstone extending in an approximate north-south direction for several miles, lying between the Colorado and Southern Railway track and the Ft. Collins-Loveland wagon road, south of Ft. Collins. Fossil Creek cuts through the ridge about five miles south of Ft. Collins, near where the ridge in its northward extension passes into the general level of the divide and thus disappears. Weathered out on the surface of this sandstone are innumerable hard, sandy concretions, from a few inches to four feet in diameter, containing large numbers of fossils, which have given to the ridge and creek the names they bear. The large size and abundance of some of the species attract the attention of even the most unobserving traveller who passes over the ridge. In the early reports the locality was variously called Fossil Ridge and Fossil Creek. As the ridge follows a definite stratigraphic horizon, while the creek cuts across strata several thousand feet in thickness, the former name seems preferable in a geological sense.

This vicinity is of peculiar interest to the paleontologist as the type locality of some interesting forms, as well as because of the pronounced intermingling of Pierre and Fox Hills species. A correct understanding of this and related sandstones may also have a very practical value in the exploration for oil.

These beds seem to occupy a position about one-third of the way up from the bottom of the Ft. Pierre Cretaceous. As the Pierre in this region is from 5,000 to 7,000 feet in thickness, the importance of finding narrow, persistent, identifiable horizons, either lithological or paleontological, within the formation, is at once apparent. Oil of excellent quality and in paying quantities is found in the Pierre at several places in Colorado, as at Boulder and Florence. There is every reason to believe that the production of petroleum may be greatly increased by