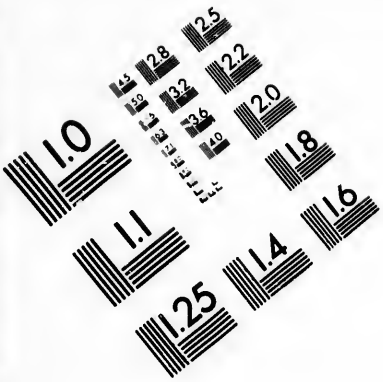

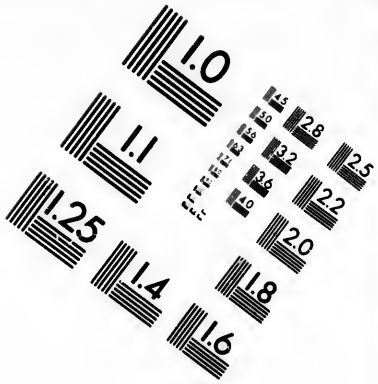

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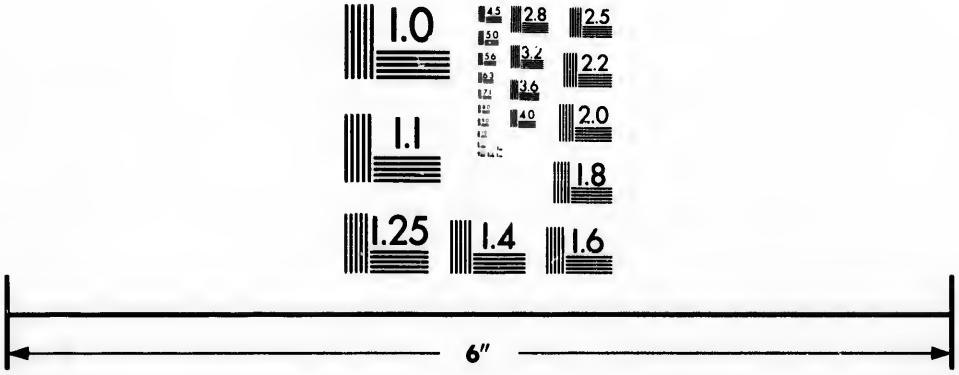

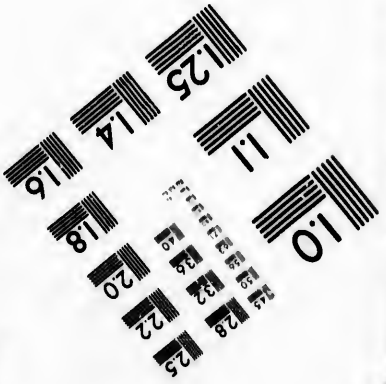

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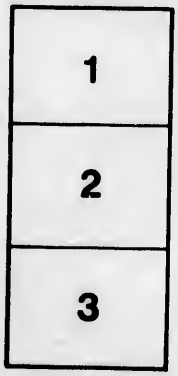

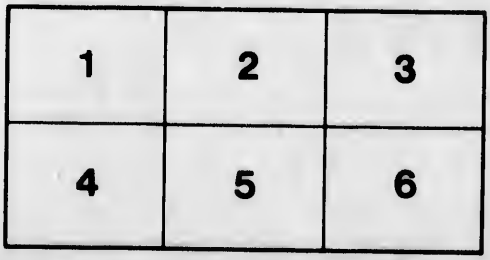

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1.—THE FISHES OF THE KLAMATH BASIN.

By CHARLES H. GILBERT, Ph. D.,

Professor of Zoology, Leland Stanford Junior University.

The Klamath River rises in the arid region east of the Cascade Mountains in south-central Oregon. After expanding to form the Klamath Lakes, it cuts its way through the mountainous region of northern California and enters the sea nearly midway between the mouths of the Columbia and Sacramento rivers. It occupies, therefore, an intermediate and closely contiguous position with respect to these two great river systems, being separated from them in many places by narrow watersheds only. It is the more remarkable that its fish-fauna should contain nothing in common with either of them, save such anadromous forms as the salmon, trout, sturgeon, and lamprey, which enter all the rivers of the coast. Such characteristic genera as *Mylocheilus*, *Acrocheilus*, and *Columbia*, of the Columbia River, and *Mylopharodon*, *Pogonichthys*, *Orthodon*, *Lavinia*, *Archoplites*, and *Hysterocarpus*, of the Sacramento, have no representatives in the Klamath. Even the genus *Ptychocheilus* is unrepresented there, though present in both the Sacramento and the Columbia, where *P. grandis* and *P. oregonensis* are but slightly different and are among the most abundant and characteristic fishes of their respective basins. A similar case is that of *Cottus asper* of the Columbia and *Cottus gulosus* of the Sacramento, two species so extremely similar that it is difficult to distinguish them, yet without any close relative in the Klamath.

The relations of the Klamath fishes become at once apparent, however, when we compare them with those of the Lahontan and Bonneville basins of Nevada and Utah.* In each of these three localities the same genera occur—among them *Chasmistes*, which is not found elsewhere—and in many cases their species are so close as to be undoubtedly representative. That the three areas have at one time formed part of the same hydrographic basin can not be questioned. Nor can we doubt that they have been separated for a very long period—long enough to permit the complete differentiation of every species within each of them—for no species is now known to be common to any two of them, if we exclude the whitefish and perhaps the trout, two forms which seem to be superior to any discoverable law of distribution.

The Lahontan Basin has been very imperfectly explored, but the facts now at hand do not warrant the assumption that it has maintained a connection with the Klamath at any time since its final separation from the Bonneville. Future exploration may be expected to throw light on this question. Important, also, will be a thorough survey of the lakes of southeastern Oregon which lie between the Lahontan and Klamath basins. Cope's investigation of these leaves much to be desired, and no facts are as

* See Cope, "On the Fishes of the Recent and Pliocene Lakes of the western part of the Great Basin, and of the Idaho Pliocene Lake." Proc. Acad. Nat. Sci. Phila. 1883, pp. 134–167.

yet available from which we can draw conclusions as to their interrelationships and recent history. Excluding anadromous fishes and the trout, the Klamath is known to contain eleven species, of which eight are peculiar to this basin, two (*Catostomus snyderi* and *Rutilus bicolor*) have been reported as well from Goose Lake, its neighbor on the east, and one species (*Catostomus oregonus*) seems to occur also in Rogue River, its neighbor on the north.

The collection here reported on was made at Klamath Falls, Oregon, in the interests of the United States Fish Commission, June 13–16, 1894, by the writer, assisted by Frank Cramer and Keinosuke Otaki. Collecting was carried on near the outlet of the Upper Lake, in the river at and below Klamath Falls, and in Lost River below Lostine. A few specimens were also secured in Willow Creek, at Ager, California. Valuable for comparison have been a few fishes collected in Scott River, Siskiyou County, California, by Mr. R. C. McGregor, and in Trinity River, Hoopa Valley, California, by Capt. W. E. Dougherty.

The lower part of Upper Klamath Lake is narrow, and is surrounded by a marginal tule belt, which is overflowed at high water. The bottom consists of mud and sand, with scattered lava bowlders. The outlet is a very rapid, turbulent stream, 50 to 75 feet wide, and falling about 85 feet between the lake and the town of Klamath Falls. It swirls around huge lava bowlders and makes imposing rapids. The temperature of the water June 13, at 9 a. m., was 56°; temperature of air, 64°. At Klamath Falls the river widens out, covering at the time of our visit extensive bottom lands, partly in tules, partly meadows. From this portion a slough makes off toward Lost River, into which it carries a considerable amount of water during early summer. Tule Lake and Lower Klamath Lake are overflow reservoirs from Klamath River, and lie lower than that stream.

At the time of our visit the lake and river contained many dead and dying fish, principally Catostomoids. *Chasmistes stomias* seemed to predominate, then *Deltistes luxatus*, *Chasmistes brevirostris*, and *Catostomus snyderi*, in the order given. The breeding season for these fish is said to be in March and April, varying from year to year with the condition of the streams. We saw no specimens entirely free from injury. Many had lost a portion of their fins, some had round holes in their sides, said to be caused by lampreys; many had diseased areas covered by a fungous growth, and a large number were afflicted by some disease of the skin of the head, which turned yellow and flaked off, leaving the skull bare. This disease often attacked and destroyed the eyes. We were told that the same fish in Tule Lake were never diseased. A few large specimens of *Rutilus bicolor* were also attacked, but other fish seemed not to be affected.

LIST OF SPECIES.

1. Entosphen... tridentatus (Gairdner).

One young specimen of this anadromous species, 26 cm. long, was taken in Klamath. They are said to be abundant in the lake, and to attack fishes, which are often seen to leap out of the water to free themselves. Several of the mutilated suckers which were examined had round wounds on their bodies, which might well have been produced by the lamprey. It is not improbable that this species has become resident in Upper Klamath Lake, as happens with other anadromous species elsewhere.

2. Acipenser medirostris Ayres.

A young specimen of the green sturgeon is in the museum of Stanford University, collected in Trinity River, Hoopa Valley, California, by Capt. W. E. Dougherty. The species was not seen at Upper Klamath Lake.

3. Catostomus rimiculus Gilbert & Snyder, new species.

† *Catostomus tahoensis* Cope, Proc. Ac. Nat. Sci. Phila. 1883, 152; Warner Lake.

This species belongs to the *C. catostomus* type, with very small scales, and is most nearly related to *C. tahoensis*. From the latter it differs in the smaller eye, less deeply cleft lower lip, blunter labial tubercles, larger scales, and the much smaller fontanelle, which is reduced in adults to a very narrow linear slit, or more commonly entirely obsolete.

Type No. 5654, Leland Stanford Junior University collection. Type locality, Trinity River, Hoopa Valley, Humboldt County, California. Collector, Capt. W. E. Dougherty. Additional specimens were collected in Scott River (Klamath Basin), Siskiyou County, California, by R. C. McGregor.

Head 4⅛ in body; depth 5; depth of caudal peduncle 2⅝ in head; eye 7½; dorsal rays 11; anal rays 7; scales in lateral line 91; above lateral line 18; from lateral line to insertion of ventral 13; before dorsal 42. Dorsal 11. Anal 7. Pectorals 17.

Head as deep as wide. Both lips full, the lobe of lower lip broadly rounded behind, the cleft not nearly reaching base of lip; the portion between mandible and apex of cleft with four series of tubercles; tubercles coarse and blunt, becoming reduced in size toward margins of lips, but less so than in related species; upper lip with five rows of tubercles. Eyes very small, the front of the eye nearly midway of head. Interorbital space convex, 2⅔ in head.

Scales comparatively smooth, gradually growing smaller posteriorly.

Dorsal fin inserted midway between end of snout and base of caudal; first ray preceded by two short, simple ones; last ray divided to base; length of base of fin equal to the height, which is contained 6¼ times in the body. Height of anal twice the length of the base; contained 5 times in body; length of pectorals 4⅔ in body; ventrals 6⅓ in body; caudal 4¼.

Color above dusky, the central parts of scales lighter; under parts white; dorsal and caudal fins dusky, others white.

The total length of the type is 266 millimeters.

In the following table the scales above the lateral line were counted from the lateral line upward and forward to a point half way between the dorsal fin and occiput; below the lateral line, downward and backward to insertion of ventral.

	Number of scales in lateral line.	Number of scales above lateral line.	Number of scales below lateral line.	Number of scales before dorsal.	Number of dorsal rays.	Number of anal rays.
Two specimens from Trinity River, Hoopa Valley, Cal., Capt. W. E. Dougherty, collector.	91	18	13	42	11	7
	81	15	12	41	11	7
Four specimens from Scott River, Siskiyou County, Cal., R. C. McGregor, collector.	85	18	12	41	11	7
	84	15	12	42	11	7
	88	15	11	42	11	7
	89	14	11	43	11	7

4. Catostomus snyderi, new species.

Catostomus labiatus Girard, Proc. Ac. Nat. Sci. Phila. 1856, 175; and of all recent authors. Not *Catostomus labiatus* Ayres, Proc. Calif. Ac. Nat. Sci. 1855, 32, from Stockton, California, and synonymous with *C. occidentalis* Ayres.

Type, No. 48222, U. S. N. M. Type locality, Upper Klamath Lake, Oregon. Collectors: Gilbert, Cramer, and Otaki.

Closely related to *C. occidentalis* and *C. macrocheilus*, differing from both species in the shorter head, smaller mouth and lips, deeper caudal peduncle, somewhat smaller scales, and in the shorter dorsal fin, which is more anteriorly inserted.

Head 4¼ in length; snout 2⅓ in head, equaling interorbital width; eye 5½; D. 11; A. 7; scales 69 to 77; above the lateral line, 13 or 14; below the lateral line, 10 or 11. Mouth very small, the width between angles but half length of snout in our largest specimen; greatest width of lobe of lower lip two-thirds diameter of eye; lower lip deeply incised, with one or two papillæ between symphysis and base of cleft: upper lip narrow, with five or six papillæ in a cross series, the uppermost becoming very small; basal portion of the lower lip with coarse tubercles, those toward posterior margin becoming very fine and arranged in evident series separated by grooves. Mucous canals on h d forming conspicuous raised ridges with prominent pores, the system much more conspicuously de loped than in any related species. Origin of dorsal fin constantly nearer snout than base of caud ; the dorsal fin short, its base not exceeding the height of the longest ray, usually less. In our specimens the

pectorals reach scarcely two-thirds distance to ventrals and the ventrals scarcely two-thirds distance to vent. The anal may extend beyond base of rudimentary caudal rays.

Scales strongly ridged, their margins crenate; the anterior scales are smaller, but do not appear greatly crowded; the average number of tubes in the lateral line is about 73, the number varying from 69 to 77. There are 13 or 14 in an oblique series from middle of back downward and backward to lateral line, and 10 or 11 between lateral line and base of ventrals.

Dusky, the lower part of sides with coarse black specks, the under parts white. Fins all dusky.

In the following table of measurements the unit is one hundredth of the length from tip of snout to base of median caudal rays. The length of caudal peduncle is taken from base of last anal ray to the vertical from base of median caudal rays:

Measurements.	No. 1.	No. 2.	No. 3.	No. 4.
Total length in millimeters	238	205	153	130
Length of head	23	23	23	23
Length of snout	11	10	10	10
Diameter of eye	4	4	4	5
Length of mandible	6½	7	7½	7
Interorbital width	10	9½	9½	10
Depth at occiput	18	17	17½	18
Depth of caudal peduncle	9½	9	9½	9½
Length of caudal peduncle	16½	18½	16	18
Distance from snout to origin of dorsal	49	49	48½	49
Distance from snout to insertion of ventrals	55	55	54½	54
Height of dorsal	16½	16½	17	18
Base of dorsal	16½	14	17	15½

In 13 specimens the fully developed dorsal rays are 11, 11, 11, 11, 11, 11, 11, 11, 11, 11, 12, 12, 12. All have 7 anal rays. In 11 specimens the oblique rows of scales above lateral line are 70, 71, 73, 73, 75, 75, 75, 75, 76, 77, 77.

A few specimens, none of them adult, were taken in Upper Klamath Lake and in Lost River. The species is named for my assistant and coworker, Mr. John O. Snyder, who first noticed that *Catostomus labiatus* was a synonym of *C. occidentalis*, and that the present species was unnamed.

5. Chasmistes brevirostris Cope.

Two species of typical *Chasmistes* inhabit Upper Klamath Lake, so similar in all their characters that it is difficult to decide to which one the name *brevirostris* properly belongs. The scale and fin formulæ are the same, and the general proportions scarcely differ. One of them has a larger, deeper head, with larger, more obliquely placed mouth, and conspicuously protruding premaxillary spines. To the other, with smooth upper profile of snout and smaller, more nearly horizontal mouth, I here apply the name *brevirostris*, following Cope's assertion that the snout "is without the hump produced by the protuberant premaxillary spines." In all other respects Cope's brief description applies equally well to both species; but the one described below as new, under the name *C. stomias*, is apparently the most abundant in the lake, and is known to the Indians by the name attributed by Cope to *C. brevirostris*.

One adult and several young specimens of *C. brevirostris* were preserved; others were seen, but were so mutilated as to be unfit for preservation. From this adult, a female 37 cm. long, the following notes are taken:

Mouth inclined at an angle of about 15°. Maxillary reaching a vertical from slightly behind front of nostrils, its length contained 1⅓ times in snout. Mandible 1¼ in snout. Lips thin, the lower interrupted at symphysis, forming moderate lobes laterally. Both lips with small, inconspicuous, sparse tubercles, those on upper lip in three or four series. In other specimens these can not be detected, owing, perhaps, to poor state of preservation. Snout 2¼ or 2⅔ in head. Interorbital width 2½ (2¼ in young). Vertical depth of head at mandibular articulation 2¼ in length of head. Mucous canals large, with very prominent series of pores on head, as apparently in all the fishes of Klamath Lake. Gillrakers slender, triangular, their free edges densely tufted. Fontanelle narrow.

Ventrals inserted under the middle of the dorsal. Front of dorsal slightly nearer tip of snout than base of caudal. Anal elongate, in the adult female reaching to opposite base of median caudal rays, doubtless extending farther in adult males. Pectorals not reaching two-thirds distance to ventrals, 1⅓ in head. Ventrals extending two-thirds distance to vent.

Scales with strong concentric striæ, the radiating ridges produced into narrow projecting lobes at margin. Seventy-three scales in the course of the lateral line; 13 in an oblique series downward and

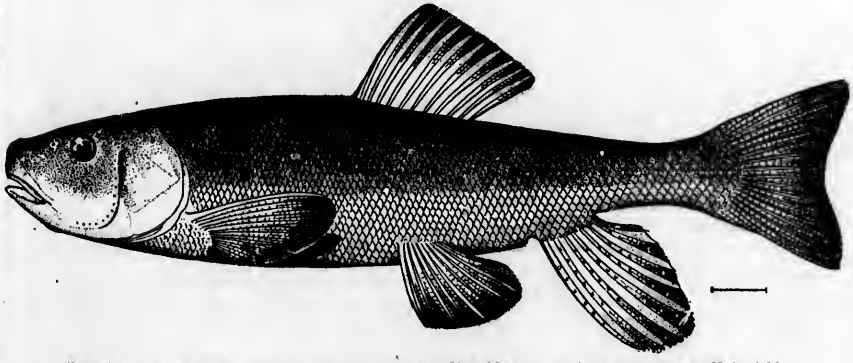
backward to lateral line from in front of dorsal; 11 in a series upward and forward from base of ventrals to lateral line; 32 or 33 oblique series crossing back in front of dorsal fin.

Color dark on upper portions of head and body, silvery on belly and lower part of sides. Fins all dusky.

The Indians to whom this fish was shown failed to distinguish it from *Catostomus snyderi*, applying to both of them the name *Yen*.

Below is a table of proportionate measurements of three specimens, the unit being hundredths of the standard length.

Measurements.	No. 1.	No. 2.	No. 3.
Total length in mm	370	250	195
Length of head	22	23⅛	22½
Length of mandible	7	8	7⅛
Length of maxillary	5	6	5⅛
Depth of head at mandibular joint	9⅛	10⅛	10⅛
Interorbital width	10	10⅛	10
Depth of caudal peduncle	8⅛	9⅛	8⅛
Length of caudal peduncle	16	16⅛	17
Snout to insertion of dorsal	48	50	48
Snout to insertion of ventrals	52	57	55



Chasmistes stomias Gilbert, new species. Drawn by A. H. Baldwin from the type (No. 48223, U. S. N. M.) from Upper Klamath Lake.

6. Chasmistes stomias, new species. Klamath name, *K-ahp-in*.

Type, No. 48223, U. S. N. M. Type locality, Upper Klamath Lake, Oregon. Collectors: Gilbert, Cramer, and Otaki.

Distinguished from all species of the genus except *C. brevirostris* by the small scales. From the latter, as already indicated, it differs in the deeper head, larger mandibles, more steeply inclined mouth, and by the presence of strongly marked protuberances on the upper side of the snout, caused by the protruding spines of the premaxillary processes.

Mouth inclined at an angle of over 45°. Maxillary longer than in *C. brevirostris*, but scarcely reaching vertical from front of nostril, its length contained 1¼ times in snout. Length of mandible exceeding that of snout in adults, in one specimen equaling distance from tip of snout to middle of eye. Lips thin, the lower interrupted at symphysis, forming narrow lateral lobes. In none of our specimens can we detect papillæ on either lip. The lower lip is ridged and slightly fringed on its lower edge. Snout 2⅛ to 2¼ in head. Interorbital width 2⅛ to 2¼. Vertical depth of head at mandibular articulation 2⅛ in length of head. Mucous canals raised to form narrow ridges, the pores conspicuous. Gillrakers long, narrowly triangular, the free margins densely tufted. Fontanelle very narrow, often shortened by a coalescence of posterior halves of parietals. In adults a median frontal crest often developed.

Ventrals inserted under middle of dorsal. Front of dorsal usually nearer tip of snout than base of caudal. Anal long, the rays extending beyond base of caudal in adult males. Pectorals nearly

reaching ventrals, the latter extending to vent in adult. Dorsal with 11 or 12 fully developed rays, anal with 7, the last ray in each divided to base.

Scales more crowded and irregular in adults of this species than in *C. brevirostris*, the posterior very conspicuously larger than the anterior. This difference between the two species is less marked in the young. The ridges on the scales are less strong in *C. stomias*. 76 to 82 scales are traversed by the lateral line; 14 or 15 scales in an oblique series downward and backward from in front of dorsal to lateral line; 11 in a series vertically upward from insertion of ventrals to lateral line; 35 to 38 oblique series before dorsal.

Upper portions of head and body blackish, the lower parts whitish or silvery, the two colors separated along a definite line traversing sides midway between lateral line and insertion of ventrals. Mandible, preopercle, and the contiguous part of cheeks whitish. Fins dusky.

Abundant in Upper Klamath Lake, where all seen were spent fish in a badly mutilated and dying condition.

Following is a table of measurements, the unit being hundredths of the standard length:

Measurements.	No. 1.	No. 2.	No. 3.
Total length in mm	370	380	220
Length of head	27½	27½	25
Length of mandible	11	12	9½
Length of maxillary	8	8½	6½
Depth of head at mandibular joint	13	14	12
Interorbital width	12½	13	11
Depth of caudal peduncle	9½	9	8½
Length of caudal peduncle	18	16½	17
Snout to insertion of dorsal	48	50	48
Snout to insertion of ventrals	54	57½	57

7. Deltistes luxatus (Cope).

Chasmistes luxatus Cope, American Naturalist 1879, 784, Upper Klamath Lake and tributaries; Proc. Ac. Nat. Sci. Phila. 1883, 149.

Catostomus rex Rosa Smith Eigenmann, American Naturalist 1891, 667, Lost River, Oregon.

Deltistes luxatus Alvin Seale, Proc. Cal. Ac. Sci. 1896, 269.

The "Lost River sucker" is the most important food-fish of the Klamath Lake region. It is apparently resident during most of the year in the deeper waters of Upper Klamath and Tule lakes, running up the rivers in incredible numbers in March and April, the height of the run varying from year to year according to the condition of the streams. The Lost River fish are the most highly prized and are said to be much fatter and of finer flavor than those ascending the tributaries of Upper Klamath Lake. Prior to 1894 an attempt had been made to preserve the meat in cans, but apparently with poor success. Oil had also been extracted from heads and entrails, said to be worth from 60 to 85 cents per gallon.

The species most closely resembles in appearance *Chasmistes fecundus*, from which it differs principally in the simpler gillrakers, as already noted by Mr. Seale. It agrees with *C. fecundus* and differs from other species of *Chasmistes* in its very long, slender head, its small, nearly horizontal mouth, and thicker lips. When these species shall have been thoroughly investigated, *C. fecundus* will probably be separated generically from *Chasmistes*.

At the time of our visit to Upper Klamath Lake, June 13 to 16, the run of suckers was well over, and the only specimens observed were the dried heads on the banks of Lost River and some more or less diseased and mutilated individuals floating about in Upper Klamath Lake and River. One young specimen only could be preserved, from which the following notes are taken:

Head 4 in length; depth 4¼. D. 12. A. 7. Lat. line 78.

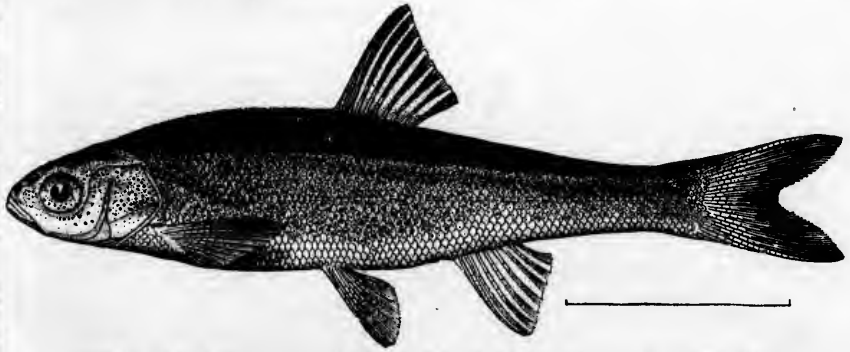
Head very long and slender, the snout and cheeks especially so, the mandibles inclined upward at an angle of about 35°. Snout tapering to a very slender tip, on the under side of which is the very small, nearly horizontal mouth, little overpassed by the premaxillaries. Premaxillary spines forming a decided hump on upper surface of snout near tip. Maxillary not reaching vertical from nostril, half length of snout. Snout 2¾ in head; interorbital width 2½; diameter of orbit (measured just within the bony rim) 5¾. Lower lip thin, but thicker and wider than in typical *Chasmistes*, the two lobes widely separated at symphysis, which is very narrowly bordered; upper lip very narrow; several series of minute papillæ on each lip. Very conspicuous mucous canals on top and sides of

head. Gillrakers short, triangular, somewhat wider than in species of *Chasmistes*, their free margins plain or moderately fringed, not bearing the dense mass of short, divided processes so conspicuously developed in *C. fecundus* and to a less degree in other species of *Chasmistes*.

Scales with concentric lines and radiating ridges very strongly marked. Seventy-eight pores in the lateral line; 14 scales in an oblique series from median line before dorsal downward and backward to lateral line; 9 scales between lateral line and base of ventrals. In 9 specimens not preserved the pores in lateral line were as follows: 76, 78, 78, 79, 79, 79, 79, 80, 81. Thirty-four series of scales before dorsal.

Ventrals inserted about under middle of dorsal. Front of dorsal slightly nearer snout than base of caudal. Last dorsal ray more than half the length of the first, which is equal to distance from snout to preopercle. Pectorals not nearly reaching ventrals, the latter not reaching vent. Anal high, the anterior rays reaching rudimentary caudal rays when deflexed. Dorsal with 12 rays, the last one divided to base. In six other specimens counted the dorsal rays were 11, 11, 11, 11, 11, 12. Anal constantly with 7 rays (in eight specimens), the last divided to base.

Very dark above, silvery on belly and lower part of sides. Dorsal and caudal dusky, the lower fins dusky on terminal half, light at base.



Leuciscus bicolor (Girard).—Drawn by Anna L. Brown from a specimen from Upper Klamath Lake.

8. Leuciscus bicolor (Girard).

Tigoma bicolor Girard, Proc. Ac. Nat. Sci. Phila. 1856, 206.

Cheonda cærulea Girard, l. c., 207. Lost River, Oregon.

Squalius cæruleus Cope, Proc. Ac. Nat. Sci. Phila. 1883, 146. Klamath Lake.

Abundant in Upper Klamath Lake and Lost River. A large species with compressed body, a tapering caudal peduncle, a small compressed head tapering to an acute snout. The snout is usually slender wedge-shaped, with straight outlines; in exceptional cases blunter and heavier. The mandible is usually included, but projects slightly at tip in some of our specimens. The mouth is gently oblique, the maxillary reaching vertical from front of orbit or slightly beyond it, its length 3¼ to 3½ in head. Eye 5 to 5½ in head in adults, 1⅞ to 1¾ in interorbital width. Teeth 2, 4–5, 2 or 2, 5–5, 2, all of them comparatively small, with deeply grooved grinding surface, in adult specimens with the hooks obsolete. The teeth differ strikingly from those in *L. lineatus*, in which they are much larger, with strong hooks and with grinding surface convexly rounded, or in older specimens beveled by use. In *L. intermedius* they are hooked and channeled.

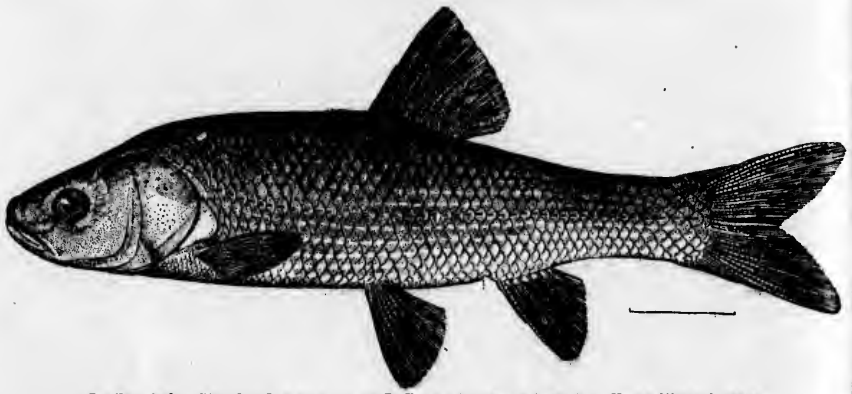
Scales marked with strong concentric lines and radiating ridges, as in *L. lineatus*. In seven specimens examined, the scales range from 65 to 67 in the course of the lateral line, 14 or 15 in an oblique series running downward and backward from the median line before dorsal to the lateral line, and 30 to 32 before dorsal (enumerating the oblique series which cross the median line).

The dorsal fin is inserted distinctly behind the ventrals and has the upper margin straight when spread, slightly concave when closed. There are usually 9 developed rays, of which the first is unbranched, the last forked to base. In 20 specimens examined, but one had 8 dorsal rays. Anal with 8 rays, the first unbranched, the last forked to base; 2 out of 20 specimens examined have 9 anal rays. The pectorals do not nearly reach the ventrals, the ventrals usually not to vent.

Color dusky above, silvery below, the middle and lower part of sides darkened by numerous coarse, black specks, which are also numerous on opercles and upper portion of cheeks. Dorsal and caudal dusky. Basal portion of anterior anal rays and inner face of pectorals dusky, the inner face of ventrals sometimes minutely black-punctate in adults. The sharp division of color between upper and lower parts, which suggested the name *bicolor*, is usually not very evident.

The following table gives proportionate measurements in hundredths of the length from tip of snout to base of caudal, in four specimens from Klamath Lake:

Measurements.	No. 1.	No. 2.	No. 3.	No. 4.
Total length in millimeters	250	175	120	92
Length of head	27	20	20	24
Length of snout	8	7	7	6
Diameter of eye	5	5	6	6
Interorbital width	9	8	8	8
Length of maxillary	8	8	7	7
Greatest depth	27	27	26	23
Least depth of caudal peduncle	10	10	11	9
Length of caudal peduncle	23	23	23	23
Distance snout to front of dorsal	54	54	50	52
Snout to ventrals	51	50	48	50
Base of dorsal	12	13	13	13
Base of anal	10	9	11	11
Height of anal	15	14	16	16
Height of dorsal	19	18	19	19
Length of pectoral	18	17	20	18
Length of ventral	15	15	16	15
Length of caudal	23	22	25	.....



Rutilus bicolor (Girard).—Drawn by Anna L. Brown from a specimen from Upper Klamath Lake.

9. Rutilus bicolor (Girard).

Algansea bicolor Girard, Proc. Ac. Nat. Sci. Phila. 1856, 183. Klamath Lake.

Myloleucus parovanus Cope, Proc. Ac. Nat. Sci. Phila. 1893, 143. Klamath and Goose lakes.

Myloleucus thalassinus Cope, l. c., 144. Goose Lake.

? *Myloleucus formosus* Cope, l. c., 144. Silver, Chewaucan, and Warner lakes. Not *Algansea formosa* Girard.

? *Leucos bicolor* Jordan & Henshaw, Report Chief of Engineers, Geogr. Surv. W. 100th Mer., 193, 1878. Warner Lake.

This species is very similar in appearance to *R. obesus* from the Truckee and Humboldt rivers and their connecting lakes, differing only in the larger scales and the additional ray in the dorsal fin. The body is robust, the mouth oblique, the snout not obtuse. The maxillary reaches the vertical from front of eye in adults and is shorter in the young. Snout 3½ to 4 in head; eye 5¼ in adults; interorbital width 2⅔ to 3⅓. Head 3⅓ to 3½ in length; depth 3⅔ to 4. Teeth 4-5, the cutting edge broad and deeply channeled in young and adults, the hook largely obsolete in the latter.

Scales marked with strong concentric lines and radiating ridges. In fifteen specimens examined, there were 47 to 52 pores in the lateral line, 10 or 11 scales in an oblique series running from median line

before dorsal obliquely downward and backward to lateral line, and 5 or 6 between base of ventrals and lateral line. One specimen has the formula 12–56–7, but is entirely exceptional. Ten specimens examined have 20 to 23 oblique series crossing median line in front of dorsal fin. The front of dorsal is slightly behind insertion of ventrals in adults, hardly noticeably so in young, always nearer base of caudal than tip of snout. Both dorsal and anal have straight margins when the fins are spread.

The following table records the fin rays in 25 specimens. The single specimen noted with 10 ventral rays had 9 rays in the ventral of the other side.

Fins.	No. of specimens.	No. of rays.
Dorsal	4	8
	19	9
	2	10
Anal	1	7
	24	8
Ventral	2	8
	22	9
	1	10

The pectorals fall far short of the ventrals, and the ventrals reach to or nearly to the vent.

As in other related species, the color is dark steel-gray above with greenish luster, growing lighter on lower half of sides. Belly white. Lower half of sides coarsely specked with black. Fins all dusky. No dark stripe along sides of head or body, and no orange on head or in axil of fins.

The following table gives proportionate measurements of parts in four specimens from Upper Klamath Lake, the unit of measurement being hundredths of the standard length from tip of snout to base of caudal:

Measurements.	No. 1.	No. 2.	No. 3.	No. 4.
Total length in millimeters	206	155	130	100
Length of head	30	27	27½	26
Length of snout	8½	8	7½	6½
Diameter of eye	5½	5½	6	7
Interorbital width	9½	10	9½	9½
Length of maxillary	8½	7½	7½	7½
Depth of body	26½	29	27½	25
Depth of caudal peduncle	12	12	11½	11½
Length of caudal peduncle	20	21	21	21
Distance, snout to front of dorsal	55½	53½	53	52½
Distance, snout to front of ventrals	51	52	52	52
Length of base of dorsal	13½	13½	13½	13½
Length of base of anal	9	9½	9½	9
Height of dorsal	19	17	19½	19½
Height of anal	15½	13	16	14
Length of pectorals	18	17	17½	18
Length of ventrals	17	16	15½	16

Numerous specimens were collected in Upper Klamath Lake and in Lost River, where it is the most abundant species. Others have been examined from Scott River, Siskiyou County, California (tributary to the Klamath River), collected by Mr. R. C. McGregor. It seems very improbable that this species should be identical with *R. parovanus* Cope, from the Utah Basin, a species which has not appeared in any recent collection. The representatives of this Great Basin type of *Rutilus* are so very similar that the status of *R. parovanus* can not be determined from current descriptions. Material from the other lakes in southern Oregon must also be carefully compared with the Klamath form. *R. thalassinus* from Goose Lake seems to agree in all the details assigned, but other specimens from Silver, Chewaucan, and Warner lakes, identified by Cope with *Rutilus formosus* (Girard), have smaller scales below the lateral line than we have found in any specimen of *R. bicolor*.

10. **Agosia klamathensis** Evermann & Meek.

Agosia klamathensis Evermann & Meek, Bull. U. S. Fish Comm. 1897. Pelican Bay, Upper Klamath Lake.

The *Agosia* of the Klamath Basin has its closest allies in *A. yarrowi* and *A. conesii* of the Upper Colorado River. These seem to have the fins strongly falcate, at least in adults, while the Klamath form has the outlines of dorsal, anal, and caudal lobes broadly rounded, even in adult breeding males. The dorsal also averages farther forward in the Klamath species, being usually located midway between base of median caudal rays and middle of snout.

The head is 3.9 to 4.2 in length. The barbels are conspicuous and constantly present. The maxillary reaches vertical from middle of nostril. The mouth is little or not at all overlapped by the snout. In adult males the paired fins are very long, the pectorals strongly overlapping the ventrals, the ventrals reaching to or beyond front of anal. In females of the same size, these fins fail to meet. In fourteen specimens examined the scales along lateral line are 70, 71, 71, 72, 72, 72, 73, 73, 74, 74, 74, 76, 77, 77. The species seems to differ from *A. nubila carringtoni* only in the smaller scales.

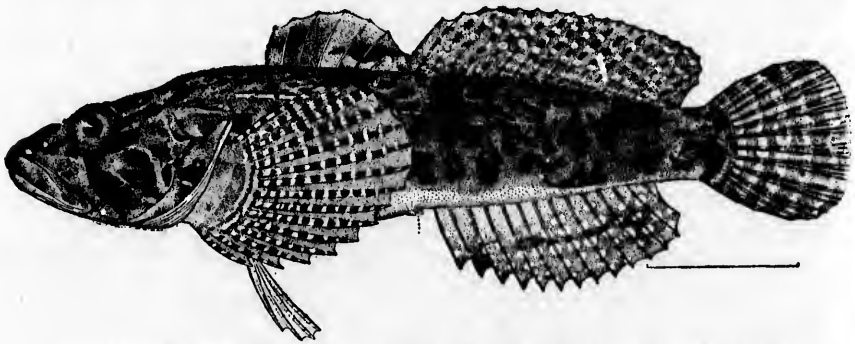
Numerous specimens were secured in Willow Creek, at Ager, California, and in Lost River. One specimen was taken in Upper Klamath Lake.

11. Salmo gairdneri Richardson.

Very abundant in Upper Klamath Lake and River; but few specimens obtained by us. These I am unable to distinguish from typical *S. gairdneri*, the larger specimens with the characteristic appearance of sea-run or landlocked fish, i. e., with few small spots and a truncate tail. Young specimens are also more silvery and with fewer spots than are found in *S. gairdneri* from coastwise streams. There is no patch of fine teeth at the base of the hyoid, nor any red dashes under the mandible. In five specimens examined, the scales are 134, 135, 136, 143, 146. As the California Fish Commission has operated on the Klamath River, it is not improbable that one or more species of trout have been planted there.

12. Salvelinus malma (Walbaum).

Reported by Cope from Williamson River; not seen by us.



Cottus klamathensis Gilbert, new species. Drawn by Anna L. Brown from the type (No. 48226, U. S. N. M.) from Upper Klamath Lake.

13. Cottus klamathensis, new species.

Uranidea minuta Cope, Proc. Ac. Nat. Sci. Phila. 1883, 152 (Klamath Lake); not of Pallas.

Type, No. 48226, U. S. Nat. Mus.; Upper Klamath Lake near Klamath Falls, Oregon, June 12, 1891. (C. H. Gilbert, Frank Cramer, and K. Otaki, collectors.)

A large, strongly marked species, very abundant in Upper Klamath Lake. It is characterized by its short, spinous dorsal, broadly joined to the long, soft dorsal, the unbranched pectoral rays, the very incomplete lateral line, the weak development of prickles, the lack of palatine teeth, and the distinctive coloration. It is most nearly related to *C. perplexus*.

Head $2\frac{9}{10}$ to $3\frac{1}{10}$ in length; depth $3\frac{9}{10}$ to $4\frac{1}{2}$. D. VII, 19; A. 14; P. 15; V. I, 4.

Body heavy and deep, the head narrowed and wedge-shaped anteriorly, the snout rather acute, and the mouth with much lateral cleft. Maxillary broadly exposed, its tip reaching vertical from behind front of pupil, its length $2\frac{1}{2}$ or $2\frac{2}{3}$ in head. Broad bands of teeth on jaws and vomer; palatines toothless. Anterior nostril with a distinct tube. Eye of moderate size, $1\frac{1}{3}$ in snout, $4\frac{1}{2}$ to 5 in head. Interorbital space and occiput gently concave in adults, the total interorbital width $1\frac{1}{2}$ to $1\frac{1}{3}$ in orbit, the bony septum narrower.

Upper preopercular spine robust, straight, directed backward, or backward and slightly upward. Below this the margin of the bone is without evident spines, but bears one or two slight prominences, which may be rounded or acute. Anterior angle of subopercle with a short spine directed forward; opercle ending in a short, flat spine. Head with large pores; two pairs above front of orbit, those

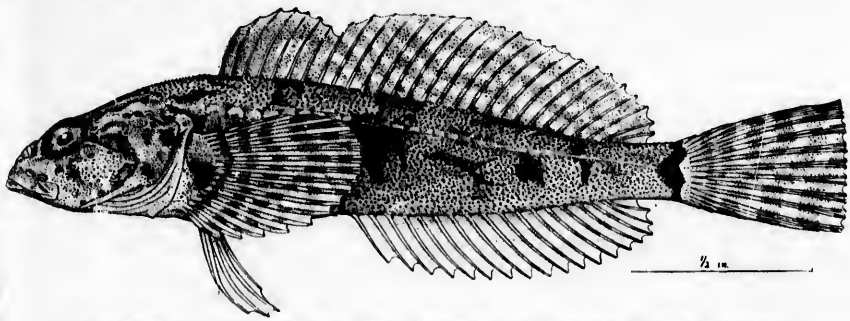
of the posterior pair nearest together; distant from these a single median pore on posterior portion of interorbital space, from which diverge two lines of pores around the back of the orbits.

The spinous dorsal is short and low, the longest spine usually less than two-thirds the longest soft ray. The two fins are very broadly joined. Distance from base of last dorsal ray to base of caudal slightly less than depth of caudal peduncle. Caudal short and broadly rounded, its length $1\frac{3}{4}$ in head. Pectorals very short, usually not reaching vertical from front of anal, $1\frac{1}{3}$ in head. Ventrals large, sometimes reaching vent, but usually shorter, $1\frac{1}{4}$ in head. Caudal with 9 (sometimes 8 or 10) forked rays; rays of other fins, including all pectoral rays, simple, unbranched.

Locality.	No. of specimens.	Spinous dorsal.		Soft dorsal.			Anal.			Pectoral.	
		VII.	VIII.	18.	19.	20.	13.	14.	15.	14.	15.
Klamath Lake	21	19	2	1	18	2	....	16	5	3	18
Klamath River below lake	4	3	1	....	4	....	1	3	....	....	4
Lost River	7	7	.....	3	3	....	2	4	1	3	5
Scott River	1	1	.....	....	1	....	....	1	....	....	1

Skin mostly naked, the young with a narrowly oblong patch of prickles below the lateral line and under the posterior half of pectorals. These become gradually absorbed with age, adults being nearly or quite naked. Lateral line very incomplete, the last pore under some portion of the anterior half of soft dorsal in all our specimens from the lake. From the last pore a shallow open groove or trace follows the course of obsolete portion of the canal. In four specimens from Klamath River below the falls, and in one collected by Mr. R. C. McGregor in Scott River, Siskiyou County, California (a tributary of Klamath River), the lateral line is much more nearly complete, ending under the last fifth of soft dorsal.

Color brownish-olive, with four or five indistinct dark bars downward from back, breaking up below into narrow bars which may unite to form V-shaped markings, or often into mere irregular blotches. A narrow bar at base of tail. Caudal with broad dark bars alternating with much narrower light ones. Dorsal and anal with somewhat narrower oblique bars. Pectorals very conspicuously checkered, the dark and light spots on the rays arranged in vertical series.



Cottus evermanni Gilbert, new species. Drawn by Chloe Lesley from the type (No. 48228, U. S. N. M.) from Lost River, Oregon.

14. **Cottus evermanni**, new species.

Type, No. 48228, U. S. Nat. Mus. Type locality, Lost River near Lostine, Oregon. (C. H. Gilbert, Frank Cramer, K. Otaki, collectors.)

Characterized by the long slender body entirely covered with coarse prickles, the short spinous dorsal very broadly united to the very long soft dorsal, the long anal fin, the incomplete lateral line, the very large pores on head, the branched pectoral rays, and the absence of any distinctly projecting preopercular spine.

Head $3\frac{1}{3}$ in length; depth 5; depth of caudal peduncle $2\frac{1}{4}$ in greatest depth. D. VII, 21; A. 18; P. 16; V. I, 4.

Head small, depressed, narrowing rapidly forward, the snout more acutely rounded than in *C. punctulatus*. Mouth with distinct lateral cleft, the maxillary reaching a vertical immediately in

advance of pupil, 2¼ in head. Mandible slightly protruding. Teeth in narrow bands on jaws, vomer and palatines, the latter very weak, apparently concealed in part beneath the skin. Total interorbital width about two-thirds diameter of eye, shallowly concave. Occipital area flat or gently convex. Eye small, 1⅛ in snout, 5 in head. Pores on head unusually large, the most conspicuous occurring on suborbital ring, along mandible and preopercle, and in a horizontal line above opercle. Three pores form a straight transverse line behind the orbits. A short nasal tube. The upper preopercular spine is represented by a short triangular process, the margin of the bone below it being smoothly rounded.

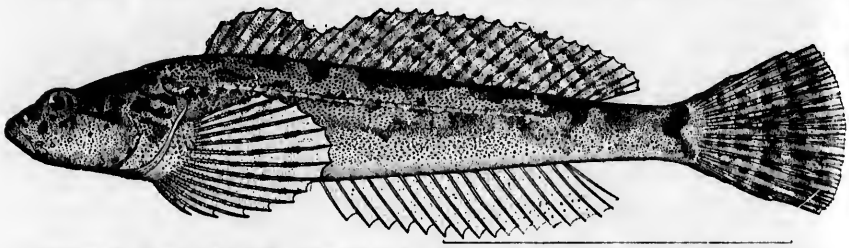
Spinous dorsal short and comparatively very high, the longest spine slightly more than three-fourths the longest soft ray. The last spine is higher than the first and about four-fifths the longest, the least height of the membrane joining last spine to first soft ray exceeding length of snout. Longest ray of soft dorsal slightly more than half head. All the rays of dorsal and anal fins simple, unbranched. Caudal long and narrow, nearly truncate when spread, six-sevenths length of head. Nine caudal rays are branched at tip for about one-fifth length of rays. The pectoral reaches the vertical from fourth ray of soft dorsal. The upper ray is simple, the next six or seven forked, the remaining rays being simple, thickened, with incised membranes. Ventrals with 1 spine and 4 rays, not reaching vent, 1⅛ in head.

Lateral line conspicuous anteriorly, running high, interrupted under eleventh or twelfth ray of soft dorsal, a mere trace visible thence to base of caudal. Sides of body thickly covered with coarse prickles, the head, breast, belly, and a narrow strip along base of anal fin naked.

Color light brownish, faintly vermiculated with darker, with traces of five irregular cross-bars from back, and a narrow distinct bar at base of caudal. Pectorals, dorsal, and caudal cross-barred.

One specimen, 59 mm. long, from Lost River, near Klamath Falls, Oregon.

Named for Dr. Barton W. Evermann, the energetic investigator of American fresh-water fishes.



Cottus princeps Gilbert, new species. Drawn by Anna L. Brown from the type (No. 48227, U. S. N. M.) from Upper Klamath Lake.

15. Cottus princeps, new species.

Type, No. 48227, U. S. Nat. Mus. Type locality, Upper Klamath Lake, Oregon. (Gilbert, Cramer, and Otaki, collectors.)

Head 3½ to 3⅝ in length; depth 5 to 5⅓. D. VI or VII, 21 to 23. A. 16 to 18. V. 1, 4. P. 15.

A slender form with small narrow head, which is nearly quadrate in cross-section, the opercles and cheeks being subvertical, the greatest width of head but one-fifth or one-sixth more than its depth at occiput. Mouth small, oblique, the gape slightly curved, the maxillary reaching a vertical crossing eye in front of pupil, 2⅔ to 3 in head. Eye equaling snout, 4⅛ in head.

Teeth small, uniform, in narrow bands in the jaws. Vomer with a narrow patch; palatine smooth. Eye small, separated by a narrow, flat interspace, as wide as pupil. Margin of preopercle evenly rounded, without developed spine, a minute spinous point sometimes occupying the position of the upper preopercular spine. Opercle without spine. Tubes and pores of head extraordinarily developed. A series of six very large pores across cheeks and on lower edge of preorbital. A large median pore at symphysis, and a series of seven occupying each ramus and extending onto edge of preopercle. Similar, somewhat smaller, pores form the supraorbital series. Branchiostegals 6. Gill membranes broadly united to the isthmus, without free fold. No pore behind last gill.

Dorsal and anal fins very long and low, the dorsal spines very slender, the notch shallow between spinous and soft portions. Pectorals reaching beyond front of anal; ventrals usually to vent.

About two-thirds of our specimens have the back and sides completely invested with minute close-set prickles, the head and belly and a narrow area along base of anal naked. The caudal peduncle is also naked in varying degree. In the remaining third (possibly males) the body is

smooth except for a postaxial band of prickles, and in one specimen these are absent, leaving the body entirely naked. Lateral line variously incomplete, interrupted at some point under posterior half of second dorsal.

Color light olive with darker markings, which may on the head take the form of vermiculating lines. Seven quadrate dark blotches along base of dorsal fin, the first and third usually narrower than the others, an eighth on back of caudal peduncle. Very distinctly marked individuals show a series of blotches along middle of sides, which may be connected with the dorsal series by broad, dusky bars. Dorsal, caudal, and pectoral with faint bars. Ventrals and anal unmarked.

I subjoin table of fin rays in 12 specimens.

Fins.	No. of specimens.	Spines or rays.
Dorsal spines	3	VI
	9	VII
Dorsal rays	7	21
	4	22
	1	23
Anal rays	2	16
	7	17
	3	18
Pectoral rays	1	14
	11	15

Numerous specimens were obtained in shallow water along the shore of Klamath Lake, on a bottom of fine sediment and vegetable débris.

This differs widely from any other species of *Cottus* in the very narrow, slender form, the long fins, and especially in the extreme development of the mucous tubes and pores.