

Jordan, D.S.  
1896

Fishes, New or  
Little known.

M.A. Stewart

NOTES ON FISHES, LITTLE KNOWN OR NEW TO  
SCIENCE.\*

BY DAVID STARR JORDAN.

(With Plates xx-xliii.)

The present paper is made up of descriptions of new species of fishes, with notes on little known forms. The material examined, unless otherwise stated, is in the Museum of the Leland Stanford Jr. University, and most of the species referred to belong to the fauna of the Eastern Pacific.

In this paper the following new genera and species are mentioned for the first time:

*Zaprora* Jordan.  
*Zaprora silenus* Jordan.  
*Salmo gairdneri crescentis* Jordan & Beardslee.  
*Salmo gairdneri bairdsteeri* Jordan & Seale.  
*Umbrina sinaloa* Scofield.  
*Emmydrichthys vulcanus* Jordan & Rutter.  
*Cottus anne* Jordan & Starks.  
*Cottus shasta* Jordan & Starks.  
*Tarandichthys* Jordan & Evermann.  
*Oligocottus borealis* Jordan & Snyder.  
*Ulca* Jordan & Evermann.  
*Eleotris abacurus* Jordan & Gilbert.  
*Clevelandia rosæ* Jordan & Evermann.  
*Brysseteres* Jordan & Evermann.  
*Arbaciota* Jordan & Evermann.  
*Rimicola* Jordan & Evermann.  
*Starksia* Jordan & Evermann.  
*Exerpes* Jordan & Evermann.  
*Chasmodes jenkinsi* Jordan & Evermann.  
*Sebastodes eigenmanni* Cramer.  
*Sebastodes gilberti* Cramer.

The accompanying plates are drawn by Miss Anna Louise Brown.

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\*Contributions to Biology from the Hopkins Seaside Laboratory. No. 5.  
PROC. CAL. ACAD. SCI., 2D SER., VOL. VI. (14) June 19, 1896.

**Zaprora silenus** Jordan.

Through the courtesy of Mr. Ashdown H. Green, President of the Natural History Society of Victoria, in British Columbia, and of Mr. John Fannin, Curator of the Provincial Museum of British Columbia, at Victoria, I have been allowed to examine the large fish to which I have given the name of *Zaprora silenus*. This specimen, twenty-nine inches in length, was taken in the harbor of Nanaimo, on Vancouver Island. It represents a new genus, allied to *Icosteus*, *Icichthys*, *Schedophilus*, *Acrotus* and *Centrolophus*, but in its combination of characters it is so different from all of these that I have been obliged to give it separate family rank. The definition of the family *Zaproridae* may for the present be that of the single known genus, *Zaprora*.

## Family ZAPRORIDÆ.

**Zaprora** Jordan, n. g.

Body robust, moderately compressed, the back not elevated, the belly not carinate. Body covered with small adherent cycloid scales, which cover the membranes of all the fins except the distal third, as also the gill membranes, lower jaw, cheeks, opercles and nuchal region. No lateral line; no spinules. Head short, the nape not elevated, the forehead broad and abruptly convex in profile; eye moderate, placed high; preopercle, parietal region, and region about eye with very large open mucous pores. No spines on head; edges of membrane bones of head covered with thick scaly skin. Mouth moderate, terminal, oblique, its cleft mainly anterior; upper jaw protractile, but not movable; maxillary rather narrow, simple; lower jaw very heavy, its thick tip projecting beyond upper jaw. Teeth alike in both jaws, rather strong, blunt, even, close-set, forming a uniform cutting

edge; no teeth on vomer, palatines or tongue, the tongue very thick. Lower pharyngeals narrow, with bluntish teeth, those on the edge larger; upper pharyngeals rather large, with small, blunt velvety teeth; no distinct tooth-like processes in the œsophagus; pseudobranchiæ present; gill-rakers very slender and flexible, rather short; gills four, a large slit behind the fourth; gill membranes separate, free from the isthmus; opercle adnate to shoulder girdle above its angle; coracoids not largely developed. Pectoral fin long, rounded, attached a little nearer ventral than dorsal outline; ventrals wholly wanting. Dorsal fin beginning above gill opening, composed entirely of simple inarticulate rays or spines, these moderately flexible, attached to the membrane to their tips, and all except the first and last of about equal length. Caudal peduncle short and stout, not contracted, the large caudal subtruncate or rounded at tip, and without procurent rays; vent nearly median. Anal much shorter than dorsal, somewhat higher, and composed of soft rays, subequal in length. Skeleton rather limp and flexible, but much less so than in *Icosteus*.

Type *Zaprora silenus*, n. sp.

This genus bears some resemblance to *Icichthys*, but differs in the stout caudal peduncle, absence of ventrals and lateral line, and in the form and structure of the head. Among the genera known to me it seems to come nearest to *Icichthys*, and it might be placed among the *Icosteida*, were it not for the presence of pharyngeal teeth. I therefore place it provisionally in a distinct family, *Zaprorida*, having at present the characters of the single known genus.

1. *Zaprora silenus* Jordan, n. sp. Plate xx.

Head  $5\frac{2}{7}$  in length to base of caudal; depth  $4\frac{1}{8}$ . D

LVI; A. 27; P. 20 to 22; C. 22; scales about 200-85. Greatest thickness of body about  $\frac{2}{3}$  its depth; length of caudal peduncle  $1\frac{2}{5}$  in its least depth, which is  $1\frac{9}{10}$  in head. Eye  $5\frac{1}{3}$  in head; snout  $5\frac{1}{3}$ ; interorbital space 3; maxillary  $2\frac{3}{4}$ , ending under front of pupil; mandible  $2\frac{1}{2}$ , its depth  $4\frac{2}{3}$ ; teeth about  $\frac{4\frac{5}{8}}{3\frac{5}{8}}$  on each side; lips, snout, and bones about eye naked; rest of head covered with small scales. Lower jaw with a thick lip slightly fringed on its edge, and with a mesial frenum; the rounded tip entering the profile when the mouth is closed. Three large pores on each ramus of mandible; behind these three others in a line on horizontal limb of preopercle; three on vertical limb; two close together in front of eye; one near the nostrils, so similar to them that there seems to be three nasal openings; seven on suborbitals; four in two rows behind eye; one above eye, and before upper edge of preopercle; a horizontal row of five along temporal region, the last and largest of all in opercular flap above gill opening; one at vertex; one between vertex and eye and two on each side of nape. Gill-rakers 8+20, the longest half eye. No trace of lateral line. Scales small, resembling those of a salmon, covering the membranes of all the fins on the basal two-thirds. Pectoral as long as head, its base  $2\frac{1}{3}$  in head; longest dorsal spine  $1\frac{5}{8}$ ; caudal  $1\frac{1}{10}$ ; longest anal ray  $1\frac{2}{5}$ . Color in spirits uniform dusky, without markings on the body, the belly pale, and the side of the head irregularly blotched with lemon yellow, apparently bright in life, and brightest about the pores of the head.

Length of type (in the Provincial Museum at Victoria, B. C.), 29 inches.

From Nanaimo, Vancouver Island. Collector, H. T. Stainton.

The type, in alcohol, has been partly skinned and

stuffed, and its form has been somewhat distorted. The form it now has is shown in the plate. In life it may have been more symmetrical, the back higher and the body deeper.

The type specimen was sent to the Provincial Museum at Victoria by Mr. H. T. Stainton of Nanaimo, who gives the following account of it in a letter to Mr. Ashdown H. Green, under date of Nanaimo, January 25, 1896:

“In reply to your favor of the 21st instant, which I have delayed answering in order to get the information you desire regarding the fish I sent to the museum. Mr. G. Marsh, a fish dealer, who gave me the fish, says it was caught on the 21st October, 1895, in the Straits of Georgia, a short distance north of Entrance Island Lighthouse [about three miles from Nanaimo—A. H. G.], by a fisherman named W. Crocker (who was fishing for codfish at the time), with a hand-line and hook baited with a piece of dogfish, in a depth of 150 feet of water. The inside, which was taken out by Mr. Marsh, was the same as that of the codfish (*Sebastodes*), and contained what appeared to be a jelly fish. When Mr. Marsh got the fish from the fisherman, it might be said to be still alive, and at that time the holes in its head were more distinct and the coloring around them of a deeper and richer lemon color than when it was packed for shipment to the museum.”

#### Family NEMICHTHYIDÆ.

#### 2. *Nemichthys avocetta* Jordan & Gilbert. Plate xxi.

Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 409. Port Gamble Wash.

In the same collection of the Provincial Museum at Victoria is a fine specimen of *Nemichthys avocetta*, the second specimen known. This was taken on the beach

at Beacon Hill, near Victoria, by Mr. Norgate, in 1894, and sent to me for examination by Mr. Fannin. This agrees with the description of the original type, the slight differences separating that from *Nemichthys scolopaceus* of the Atlantic being constant. A generic character of *Nemichthys* not heretofore noticed is the division of the dorsal rays into two sorts, near the middle of the body, the anterior series being much longer than the others, and all being undivided or spine-like. This character is shown in the accompanying plates, taken from the Nainimo specimen. This character does not exist in the related genus *Avocettina*.

3. *Avocettina gillii* (Bean). Plate xxi.

*Labichthys gillii* Bean, Proc. U. S. Nat. Mus., 1890, 45. Prince of Wales Island, Alaska.

For purposes of comparison, I present a figure of *Avocettina gillii*, from a specimen (No. 679, L. S. Jr. Univ.) taken by the Albatross at Station 2860. The genus *Avocettina* differs from *Labichthys* and *Nemichthys* in the backward position of the vent, and there is no division in the dorsal rays like that seen in *Nemichthys*.

THE TROUT OF LAKE CRESCENT, WASHINGTON.

Some months since Rear Admiral L. A. Beardslee, U. S. N., called my attention to the splendid trout found in Lake Crescent, a mountain lake in the Olympic Range, above Port Angeles, Washington. These trout, according to his view, were of two species, one or both of them new to science. These are locally known as the "Blue-back" and the "Speckled" trout.

Recently, through the kindness of Mr. M. J. Carrigan of Port Angeles, and Mr. George E. Mitchell of Fairholme, one specimen of the speckled trout and two of the blue-back have been sent to me for examination. I find

myself forced to agree with Admiral Beardslee in the opinion that each of these forms is distinct from any previously recorded or named. The two are allied to each other, rather than to any other form, and the nearest affinities of both seem to be with the steelhead trout (*Salmo gairdneri*) rather than any other. But placing the two as subspecies of *Salmo gairdneri* is simply a provisional arrangement, and there is just as good warrant for regarding each as a distinct species.

From all forms of *Salmo gairdneri* both the new forms differ in the large size of the head as well as in coloration and in the form of the snout and opercles. The size of scales, the form of the gill-rakers, the form of the opercle, the form of the pyloric cæca, the outline of the caudal, and the coloration, are different in the two forms.

4. *Salmo gairdneri crescentis* Jordan & Beardslee, n. subsp. SPECKLED TROUT OF LAKE CRESCENT. Plate xxii.

Head  $3\frac{4}{5}$  in length to base of caudal; depth 5; exposed portion of eye 6 in head,  $1\frac{2}{3}$  in snout; scales 32-151-34, 151 cross-series, 83 in front of dorsal; dorsal with 10 branched rays, anal with 11; branchiostegals 10; gill-rakers 6+11, counting rudiments, these very short and thick, the longest but  $\frac{3}{16}$  inches in length,  $18\frac{1}{2}$  in maxillary; mouth large, maxillary extending much beyond eye,  $1\frac{2}{3}$  in head, with about 20 teeth; tongue with the usual teeth; teeth on vomer in zigzag series; hyoid region of tongue without teeth. Snout  $3\frac{1}{2}$  in head; preorbital very narrow, not so wide as maxillary adjacent to it; the posterior suborbitals longer than eye,  $5\frac{1}{3}$  in head; opercle and subopercle very narrow, scarcely as wide as eye, the free part of opercle  $6\frac{1}{3}$  in head; interorbital width  $4\frac{1}{4}$  in head. Origin of dorsal in middle of length of body, its margin straight, anterior  $2\frac{1}{2}$  times posterior, and slightly

longer than base,  $2\frac{1}{3}$  in head. Last ray of dorsal pointed. Origin of anal midway between origin of dorsal and base of caudal, margin irregular, anterior rays three times length of posterior, and equal to base of fin,  $2\frac{2}{5}$  in head. Adipose fin high and slender, situated immediately behind anal. Pectoral  $1\frac{4}{5}$  in head. Ventrals under middle of dorsal,  $2\frac{3}{5}$  in head. Caudal broad, slightly emarginate, nearly truncate when spread, its corners not rounded, its longest rays  $1\frac{1}{2}$  in head. Least depth of caudal peduncle  $3\frac{3}{5}$  in head. Pyloric cœca about 51, the longest about  $1\frac{5}{8}$  in head, and very slender. Color in alcohol very dark steel blue above, becoming paler below, nearly white anteriorly on belly where only the margins of the scales are punctate; no silvery anywhere; lower jaw dusky, a large black blotch on cheek between suborbital and premaxillary. Sides, back, top of head, dorsal and caudal fins with few small dark spots; pectorals dusky, slightly spotted at base; anal slightly dusky, without spots; ventrals dusky with a few spots in middle; adipose fin with a few spots; lower fins all tipped with pale, probably yellowish red in life. Spots all very small and faint, not confined to posterior part of body.

The specimen before us, No. 1863, L. S. Jr. Univ., is a male,  $18\frac{1}{4}$  inches long. It was taken at Fairholme on Lake Crescent, Clallam county, Washington, March 12, 1896, by Mrs. G. E. Mitchell of Fairholme.

The following account of Lake Crescent is given by Mr. M. J. Carrigan:

“Lake Crescent, from which the blue-backs are taken, is about twenty miles from Port Angeles, and is a most beautiful and prolific body of water. It is in the Olympic Mountains, is seven hundred feet above the level of the sea, and in size is about ten miles long by two miles wide. It is very deep, many hundreds of feet in places, and its

waters are very cold. Its water supply comes in large part from the snow from the mountains which rise from its shores in great majesty and almost completely surround it. The fishing there is really magnificent, especially fly-fishing. Several varieties of trout abound, but the blue-back is the handsomest and gamest fish in the lake. They afford one great sport. Those that the Admiral took measured from twenty-eight to thirty-two inches in length, and averaged about ten pounds each in weight. He has doubtless furnished you with exact data regarding his fine catch there."

5. *Salmo gairdneri beardsleei* Jordan & Seale, n. subsp.

BLUE-BACK TROUT OF LAKE CRESCENT. Plate xxiii.

Head  $3\frac{4}{5}$  in length to base of caudal; depth about 4; eye  $4\frac{5}{8}$  in head,  $1\frac{2}{5}$  in snout; scales 24-130-20, 130 cross series, those in front of dorsal numerous, about seventy if counted along median line, sixty if the rows along upper side are counted; dorsal with 10 branched rays; anal with 11 branched rays; branchiostegals 11; gill-rakers 8+13, rather long and slender, the longest nearly  $\frac{5}{16}$  inch in length, 7 to 9 in maxillary. Head pointed; mouth rather large; maxillary extending to hinder margin of eye,  $1\frac{4}{5}$  in head, with about 20 teeth; snout  $3\frac{3}{5}$  in head; preorbital very narrow, the maxillary almost touching the orbit; posterior suborbitals shorter than eye, about 6 in head; opercle not very broad, equal to eye, its free part  $4\frac{5}{8}$  in head; interorbital width  $3\frac{3}{5}$  in head, equal to snout; several large teeth along margin of tongue; no hyoid teeth; teeth on vomer in zigzag series. Origin of dorsal in middle of the length, margin slightly concave, the first ray  $1\frac{5}{8}$  times last, the last ray being pointed, slightly greater than base,  $2\frac{1}{10}$  in head. Origin of anal midway between origin of dorsal and base of caudal, margin straight, the tip of the last ray slightly exserted; anterior

rays  $3\frac{1}{4}$  times posterior, and equal to base of fin,  $2\frac{1}{3}$  in head. Adipose fin high and slender, situated above or anterior to end of anal. Pectorals  $1\frac{1}{2}$  in head; ventrals under middle of dorsal,  $2\frac{1}{3}$  in head. Caudal broad, nearly truncate, the middle portions abruptly lunate when spread open, with pointed angles, each lobe being somewhat convex on its edge; longest rays  $1\frac{1}{3}$  in head. Least depth of caudal peduncle  $2\frac{3}{4}$  in head. Pyloric cœca 50 to 60, short and thick, the longest about 3 in head. Color in spirits very dark blue above, sides abruptly brighter, with many scales abruptly silvery; below white, lower jaw white, its margin dusky; cheeks below suborbitals very dark; sides, top of head, dorsal and caudal fins spotted, the spots all very small; pectorals and ventrals nearly colorless, without spots, and slightly dusky; adipose fin with two spots; tips of lower fins faintly tinged with yellowish.

Two specimens, each 16 inches long, Nos. 1861 and 1862, L. S. Jr. Univ. They were taken on March 12 and 16, 1896, in Lake Crescent, by Mrs. George E. Mitchell of Fairholme, and sent to us by Mr. M. J. Carrigan of Port Angeles. No. 1864, L. S. Jr. Univ.

A third specimen of much larger size, afterwards sent to us, shows the following characters:

Head  $3\frac{5}{8}$ ; depth  $3\frac{2}{3}$ ; D. 12; A. 12 branched rays; branchiostegals 11 or 12; scales 23-123-26, 64 before dorsal; snout  $2\frac{5}{8}$ ; eye  $7\frac{2}{3}$ ; maxillary  $1\frac{2}{3}$  in head, its depth 8 in its length.

Body robust, little compressed; head large, maxillary moderate, extending beyond eye; opercle moderate, its width  $5\frac{2}{3}$  in head. Last ray of dorsal pointed. Caudal subtruncate, lunate mesially, each lobe somewhat convex, pointed at tip. Caudal peduncle short and thick. Series of vomerine teeth long, in double row. Color above dark green, with black spots which are small and sparse

on body, extending to below lateral line; many small spots on head, dorsal and caudal; spots not more numerous behind than before; sides and belly bright silvery; no red on lower jaw; a faint pink shade along lateral line; pectorals colorless except the upper ray; ventrals and anal colorless; flesh pale; gill-rakers removed.

This specimen, male, was taken in Lake Crescent. Length  $26\frac{1}{2}$  inches; weight in life 14 pounds.

This specimen differs from a large *gairdneri* most in the large scales. In addition the head is much larger, and the body deeper.

A fourth still larger specimen (No. 1865, L. S. Jr. Univ.), an old spent male, 27 inches long, has been still later received. It shows the following characters:

D. 11; A. 12. Head  $3\frac{2}{3}$  in length. Gill-rakers 8+12, of medium size, rather broad but sharp pointed; opercle  $3\frac{1}{2}$  in head; eye 7 in head; B. 11. Maxillary long, reaching beyond the eye,  $1\frac{2}{3}$  in head, its width  $9\frac{1}{2}$  in length. A double row of sharp teeth extending to within a short distance of end, where they are replaced by a single row of slightly larger teeth; teeth on tongue rather large; no teeth on hyoid; teeth on vomer in zigzag series. Scales 26-137.

This specimen, a spent male, has the flabby muscles and slimy half concealed scales of the spent male salmon. The dark dots are very numerous and small and show very distinctly on back and sides, as also on head and fins. There is a dull red lateral band on head and body. This is about an inch broad, its outlines diffuse: A black blotch on cheek; maxillary dusky with a red blotch toward its tip. Lower jaw and branchiostegals dusky; pectoral, ventral and anal dark; back dark green, belly dusky.

The following account of the life-coloration of *Salmo beardsleei* is given by Mr. George E. Mitchell.

“ The Blue-back Trout caught in Lake Crescent are on the back a deep dark-blue ultra-marine color of a peculiar transparency, dotted with small round black spots from the size of a pin's head to a little larger. The two fins on the top of the back are a dark smoky color, also dotted as on back end and are transparent. The tail is the color and transparency with dots also—same as the top fins. The side fins and the bottom fins are dead white and sometimes faintly tinged with a pinkish hue at the edges; the belly is white. Looking at the fish sideways the sides of the fish show the scales to be iridescent, the red flash predominating. The head has very much the polish of mother-of-pearl around the lower jaws and jowls, red and pale blue colors predominating; under the eyes a few black spots; on top of head the blue much darker than on top of back—so dark in fact that the black spots on it look blacker than the rest. The nearer the shore these fish are caught the lighter the blue on back, the fish often having an impression of the surroundings distinctly marked on them.”

The following notes are added by Admiral Beardslee:

#### HABITS.

The Blueback is a deep water dweller; those taken by me in late October were caught at depths varying from 30 to 50 feet, on large spoons. They fought hard until brought near surface, then gave up, and when landed were found puffed up with air. Specimens taken in spring and put in pools in mountain streams with other trout died very soon, while the others lived. The trout caught by Mr. Mitchell, in March, was taken near bottom, by a large spoon, and it is not on record that at so early a date one has previously been caught.

BLUEBACKS FROM LAKE CRESCENT, WASHINGTON.

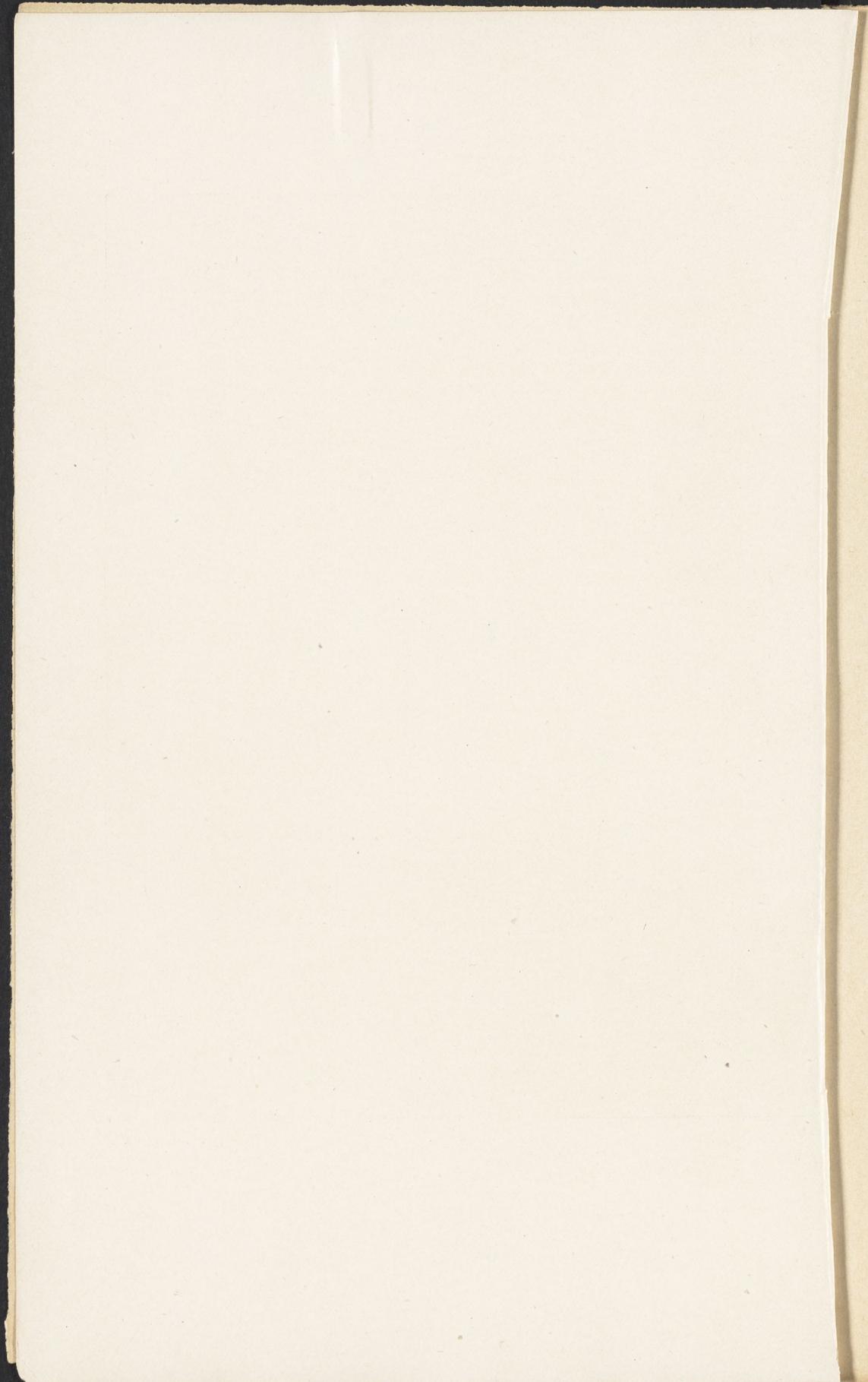


L. A. BEARDSLEE.

6 11½ 11 11½

M. J. CARRIGAN.

TWO HOURS' WORK, OCTOBER 28, 1895.



## FLESH.

Light lemon color before cooking; devoid of the oily salmon flavor, and very excellent; whitening by cooking.

## OVA.

October 28—The eggs in the large fish were in *individual* size, and in size of cluster much smaller than those of a salmon of the same size.

The following extracts from a letter from Mr. Carrigan, dated Port Angeles, April 30th, are of much interest:

\* \* \* Answering your direct inquiries: The Beardslees and Crescents are readily distinguishable, and can always be told apart.

There are no red spots at the points indicated on the Crescent trout—no markings to suggest the Cut-throat trout.

There are no Cut-throat trout in Lake Crescent.

The Beardslees (Bluebacks) are taken in deep water. Those caught by the Admiral and myself were taken in from 25 to 35 feet of water.

The known varieties of trout in the lake are:

- (a) "Beardslees."
- (b) "Crescents."
- (c) "Silvers" (the local name for a very beautiful trout, that measure, as a rule, from 12 to 18 inches in length; but I have seen specimens 22 inches long, and there are doubtless much longer ones in the lake).

(d) "Half-breeds" (the local name for a long, slender, graceful trout, that seems to be a cross between the Beardslees and Crescents. The markings of the fish, as I recall them after last season's fishing, are a rather pale olive-green back and silver sides; the head and back being dotted with rather faint small black spots. The shape of the fish is one of its distinctive features. The flesh is pale lemon colored).

Handle with  
care.

Please return  
when finished.

# PHONE CALL

Date \_\_\_\_\_

M. \_\_\_\_\_

You were called at \_\_\_\_\_

By M. \_\_\_\_\_

Return the call to \_\_\_\_\_

The message was \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(e) "Mountain trout" (a variety that evidently comes into the lake from the mountain streams that empty into it).

The possibilities of the beautiful mountain lake have never been fully tested. The Admiral (Beardslee), when he comes up in June, will fish it at all depths, and there is no telling what new surprises he may bring forth. The lake is about 10 miles long by 2 or  $2\frac{1}{2}$  miles wide, and deep water is found everywhere close to shore. In places a 500 foot lead-line will not sound bottom. No one really knows what depths of water exists in the lake beneath the 500 foot sounding, or what size or variety of trout can be taken at depths lower than those so successfully tried by Admiral Beardslee. But we will know this season; and you will be promptly acquainted with everything new or of interest that is brought forth.

\* \* \* High up on the side of one of the mountains surrounding the lake—probably 2,500 or 3,000 feet above the lake—is a pretty little lake containing what I believe will also prove a new variety of trout. Specimens of the variety are found every spring, after the freshets caused in the mountain streams by melting snow, floating on the surface of Lake Crescent, dead. They are evidently carried out of the little lake by the torrent and are battered to death in going over the falls in the creek, for streams empty into the little lake that have their origin up near the crest of the mountain. Mrs. Carrigan found one of these trout floating on Lake Crescent about ten days ago. It was still alive, but died directly after being taken into the boat. Its head and body were all bruised and battered, and its tail fin was broken and in shreds. It may be that the little lake is the home for what we, for want of a better name, call Half-breeds. We will go up to the little lake this summer, and secure some good specimens of the trout it contains. \* \* \*

In a letter to Admiral Beardslee, dated April 19th, Mr. Carrigan gives these further details, especially interesting to the angler:

\* \* \* I have some news that will interest you. We have a young lady friend visiting us—Miss Sara Beazley of Columbia, Missouri. On Friday, the 17th inst., Mrs. Carrigan and Miss Beazley drove out to Lake Crescent to spend a few days with Mrs. Mitchell. They returned in triumph at 4 o'clock this afternoon, with four trout weighing 21 pounds.

Miss Beazley, Mrs. Mitchell and Mrs. Carrigan went out fishing at 10:30 yesterday, Saturday morning, April 18th. They took the copper wire troll that you sent to Mrs. Mitchell and Miss Beazley did the fishing, using trout belly for bait. When off Eagle Point, at 11:30, Miss Beazley caught and successfully landed a magnificent speckled trout that measured 27 inches in length, was 6 inches through, and weighed 8 pounds. The top of the head and back of the fish is a dark blackish green, the head and back being thickly covered with quite large round black spots which extend down the sides about halfway to the median line. From there to the median line the black spots are equally thick, but are irregular in form, two and sometimes three spots lapping on to each other, making angular looking black spots of various sizes, some of them quite large. The irregular spots extend in a scattering way below the median line. The tail is thickly marked with round black spots.

The upper jaws and gill plates have the appearance of clouded reddish mother-of-pearl, somewhat iridescent. In some lights the "reddish" shade has a burnished copper effect, and in other lights it presents a pale magenta shade. There are six large round black spots on each side of the head, on the upper and back portion of

these mother-of-pearl plates (on a line back of the eyes). The back fins are blackish green, heavily dotted with round black spots. The side and belly fins are of smoky gray, opaque, and entirely free of spots.

Miss Beazley had a great struggle landing the fish. It made a fine fight, towing the boat for a long distance. She landed him without a gaff-hook.

About an hour later in the same locality Miss Beazley caught a one-pound Bearsdslee. The party then went home to luncheon, and at 4:30 started out again, Miss Beazley still managing the troll, and Mrs. Mitchell managing the boat. At 6:30 o'clock, when off Eagle Point, Miss Beazley caught and landed (without a gaff, also) a superb Beardslee that measured  $29\frac{1}{2}$  inches in length and 8 inches through, and weighed strong 10 pounds. It was a beautiful specimen and made a fierce and prolonged fight. It raced along with the boat (the wind slight favoring its "tow") for a long distance below the point, and made several desperate and out-of-the-water leaps and plunges to get away; but it had swallowed the hook and was securely caught. As soon as it struck the bottom of the boat, on being taken over the side, it began a terrific struggle to get back into the water, and both Miss Beazley and Mrs. Mitchell had to throw themselves upon him and hold him down with their knees. When he was finally killed and the hook removed, it was found that in his struggle for freedom he had badly bent the shank between the spoon and the hooks; but it held fast, to the delight of the three ladies, who made the lake ring with their exultant exclamations. I don't suppose there ever were three happier women.

On their way home, Miss Beazley landed a beautiful two-pound Crescent.

Both of the big trout were caught just as the wind

freshened into a strong breeze, and were taken in from 30 to 35 feet of water. The women followed the plan of rowing along slowly; stopping rowing altogether for a few seconds, and then starting off again slowly. Both fish were taken just as the boat started up, after one of three brief stops, during which the troll had gone down to a greater depth than when the boat was in motion.

I examined the Beardslees with great care just after the women reached home this afternoon, and have settled these points definitely: The head is densely spotted with round black spots down as far as the mother-of-pearl gill plates, but no further. There are no black spots on these plates. The blue on the back extends down almost to the median line, and the entire back, from head to tail, and on either side halfway down to the median line, is thickly marked with round black spots which decrease in size as the tail is approached. The tail itself is densely dotted with round black spots, as are also the back fins. The side and belly fins are not spotted. The black spots on the back are not so prominent as on the smooth surface of the head, owing to the presence of the scales on the back and sides, but they are there in great numbers.

I noticed this difference between the marking of the one-pound and the ten-pound Beardslee. On the one-pound fish there is a well-defined line of large round dark spots extending the whole length of the body, from a point just back of the gills to the tail fin, and midway between the median line and the bottom of the belly. There are 17 of those spots grading down in size. These spots are not a pronounced black, but show out plainly enough from beneath the whitish silver scales, presenting the dark dull appearance of human flesh

bruised by a blow. These spots are entirely absent from the ten-pound Beardslee.

\* \* \* On Friday, April 17th, just before Mrs. Carrigan and Miss Beazley arrived at the lake (it was about 6 o'clock in the afternoon) Mrs. Mitchell caught, with the gear you sent her, a twelve-pound Beardslee, measuring 30 inches in length and  $8\frac{1}{2}$  inches through. She is immensely proud of your gift, which is doing such splendid work so early in the season.

These fine catches made by the ladies prove the possibilities of the lake in early spring; your own splendid success demonstrates what can be done late in the fall, at the very tail end of the season. It remains for you to show what can be done in the heat of the season. There is no knowing what surprises may result from the deep fishing that you will do this summer, for I know that you will give the lake a thorough test at all depths.

It would be a good idea to take out, when you go there this summer, a proper rig for sounding the lake, which has never yet been sounded.

It is my conviction that you will shatter your own big trout record all to pieces this summer, and give the fishing world a series of fresh surprises.

\* \* \* The Eagle Point stream has its origin in a little lake high up on the mountain side, probably 2,000 feet above Lake Crescent. There is a high and very pretty water-fall in the stream. On the mountain side of the little lake are trout, and the fish the ladies picked up on Crescent Lake evidently came from this little lake, being battered to death in coming over the fall. The men who run the launch say that the spring freshets bring down large numbers of trout from this little lake, and that many of them are killed in the descent.

In a letter to me, dated May 5, 1896, Mr. Carrigan

gives further notes of interest concerning the third specimen described above:

I have just forwarded to you a 14-pound "*Crescent Lake trout*" (the Blueback), which was caught at Lake Crescent, Sunday afternoon, by Mr. Ben. Lewis. This trout, when taken from the water, weighed full 14 pounds, measured 32 inches in length and 8½ inches in width. Mr. Lewis at once started for Port Angeles, to present the trout to me to be forwarded to you, for I had told him that I was anxious to send you a large specimen of the Crescent trout, that you might note its special characteristics. He rowed over the lake, 8 miles, and walked into Angeles, 20 miles more, carrying this trout on his back, arriving here at midnight. We were both desirous of getting the fish off to you as promptly as possible and in the best condition, but it was impossible to get any ice here yesterday, and we had to keep the trout as best we could until the ice we telegraphed for arrived from Seattle to-day.

It is a magnificent specimen of the "*Salmo beardsleei*," and certainly presented a splendid appearance when first unrolled from Mr. Lewis' pack-sack. It was then sweet, fresh and plump. I hope it will reach you in good condition. We packed it carefully in ice before sending it forward.

It is a pity that we cannot get one of these fish to you, showing its beautiful life coloring. When freshly taken from the water the head and back of the trout is a very deep, rich blue, which extends well down to the median line, and below the median line all is gleaming, creamy white, with a sheen as bright as burnished silver, and iridescent. The head, back and tail are strongly marked with black spots.

The beautiful blue coloring of the back fades out after

death and loss of blood, and changes to a shade of silvery green. I don't know what the fish look like when they reach you, but they have lost their royal coloring before they leave here.

Mr. Lewis has just told me of an entirely new variety of trout that he catches in the lake, at a depth of from 80 to 100 feet. He takes them on set lines, which he places out over night, and says he has never been able to catch one of this species in any other way. He says it differs from any other trout in the lake; that it is a long, slender, graceful and very attractive fish, with a grayish green back and below the median line, pure white sides and belly. He has promised to secure a specimen of this variety for me to be sent to you.

#### Family LUTIANIDÆ.

#### 6. *Xenocys jessia* Jordan & Bollman. Plate xxiv.

*Xenocys jessia* Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 160. Charles Island, Galapagos.

The figure of this handsome species is taken from one of the original types.

#### Family SCLÆNIDÆ.

#### 7. *Umbrina sinaloæ* Scofield, n. sp. Plate xxv.

Head  $3\frac{9}{10}$ ; depth  $3\frac{6}{10}$ ; eye  $3\frac{3}{4}$  in head; snout  $3\frac{1}{3}$ ; interorbital space  $4\frac{1}{4}$ ; tip of snout to end of maxillary  $2\frac{1}{2}$ ; D. X-I, 28; A. II, 6; scales 7-51-10; (scales 7 between front of dorsal and lateral line, 10 between line and vent; 51 pores in lateral line to base of caudal); pectorals  $1\frac{2}{3}$  in head; ventral  $1\frac{2}{5}$ ; second anal spine  $2\frac{1}{4}$ ; third dorsal spine longest,  $1\frac{2}{3}$  in head; gill-rakers 6+9, rather slender, about  $\frac{1}{2}$  as long as pupil; distance to anal  $1\frac{1}{2}$  in length ( $1\frac{1}{3}$  in *xanti*); barbel slender; caudal slightly lunate, the upper lobe the longer. Color dark

above (greenish in life), silvery below; a dark blotch on opercle; conspicuous dark olive stripes follow the center of the scale rows upward and backward on the sides and back; stripes about  $\frac{1}{2}$  as wide as pupil; spinous dorsal dusky; ventrals and anal pale, without punctulations; lining of gill cavity quite dark; gill membranes pale; peritoneum pale.

Resembles *Umbrina xanti* very closely; but is distinguished by the dark gill cavity, the small scales, small second anal spine, and more anterior position of anal. The stripes on the body are slightly darker, not so undulating, and there are a few more of them, due to the smaller and more regular scales.

Length 8 inches.

Type No. 1632, L. S. Jr. Univ. Mus., collected at Mazatlan by the Hopkins expedition of 1894. Several specimens were obtained in company with *Umbrina xanti*. It is equally abundant, having been hitherto confounded with the latter species. I may note that specimens of the Californian species, *Umbrina roncadorensis*, are in the collection from Guaymas.

#### Family SCORPÆNIDÆ.

#### 8. *Emmydrichthys vulcanus* Jordan & Rutter, n. gen. and sp. Plate xxvi.

##### *Generic description:*

Body short and stout, length of head about equal to depth; body with no scales, thickly covered with irregular dermal prominences. Cleft of mouth vertical. A band of minute depressible teeth in each jaw, none on vomer or palatines. Tongue free, short and broad. Opercles unarmed, covered with thick loose skin. Gill openings very long. Eyes with an almost vertical range, the interorbital space very deep, a large pit behind and

one below each eye. Dorsal divided by a deep notch, the anterior part with nine, the posterior with two spines; anal with three. Anterior spines of dorsal each with a pair of antero-lateral grooves.

The new genus *Emmydrichthys* is closely related to *Synanceia* Bloch, differing in having the dorsal divided and with a smaller number of spines, and in the presence of a deep pit or groove below eyes.

Head  $2\frac{1}{3}$  in length, depth  $2\frac{1}{3}$ . D. IX-II, 7; A. III, 6; P. 18. Gill opening extending forward almost to below mouth, almost as long as depth of body. Head with many pits and irregular protuberances. Eyes situated on the outer sides of a pair of protuberances, the interorbital space very deep and nearly smooth, a large cavity behind each eye and a smaller one below. A small papilla on upper side of eyeball. Jaws equal, fringed with cirri. Anterior nostril tubular. Dorsal fins connected at base. Fin membranes all thick and heavily papillose, greatly thickened around anterior dorsal spines. Eyes midway between snout and origin of dorsal. Middle dorsal spines slightly longest, about equal to distance of first spine from pupil; longest pectoral rays, third and fourth from top, equal to distance of dorsal from tip of lower jaw; anal not so high as soft dorsal; caudal small, rounded, shorter than ventrals; ventrals with two-thirds of inner side grown to body. Color, in alcohol, nearly entirely jet black, the tips of the warty processes on head washed with white, and some minute whitish streaks on under edge of eye.

This specimen, in color and appearance, bears an astonishing resemblance to a lump of black lava.\* This is undoubtedly a matter of mimicry, and its native haunt must be among volcanic rocks.

The type specimen,  $9\frac{1}{2}$  inches long, was sent to the

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\* Hence the name from *μῦδος*, a lump of lava.

museum of California College, Oakland, by Rev. J. H. Henry of Tahiti. It was said to have been taken at the Hawaiian Islands. By the courtesy of Professor Inskeep of this institution we have been permitted to examine this type. The species is called by the natives No-ho, and its poisonous dorsal spines cause it to be greatly dreaded.

Family COTTIDÆ.

9. *Cottus annæ* Jordan & Starks, n. sp. Plate xxvii.

Head  $3\frac{1}{2}$  to  $3\frac{3}{4}$  in body, depth 5. D. VII or VIII-16 or 17; A. 12; eye 5 in head; maxillary  $3\frac{2}{3}$ ; highest dorsal spine  $3\frac{1}{2}$ ; highest soft ray 2; pectoral 1; ventral  $1\frac{2}{3}$ ; caudal  $1\frac{1}{4}$ .

Body elongate, not much compressed; caudal peduncle wide, wider than length of snout. Head small, broadly rounded anteriorly as viewed from above; snout blunt as viewed from the side; mouth very small, without so much lateral cleft as in *Cottus beldingi* or *C. philonips*, the maxillary reaching to front of pupil; teeth in moderately wide bands on jaws and vomer; palatines toothless or with a few teeth in a narrow band on front; interorbital (bone only) equals  $\frac{1}{2}$  eye; eye smaller than length of snout; preopercle with only one small blunt spine, below which its edge is entire. Pectoral barely reaching front of anal; spinous dorsal very low, from  $\frac{1}{2}$  to  $\frac{2}{3}$  as high as soft dorsal, its base from its first spine to first ray of soft dorsal  $1\frac{1}{4}$  in head; dorsals barely meeting, not at all connected.

Color light gray, somewhat mottled; ventrals and anal colorless, other fins crossed with wavy lines; a black spot on each end of spinous dorsal.

We have compared these specimens with specimens of *Cottus beldingi* from Birch Creek, Idaho, and from other localities as also with a single type specimen of *Cottus*

*philonips* from Field, B. C. It differs from both of these in having the mouth and eyes smaller, and from the Field specimen in having a deeper body.

Here described from four specimens from  $2\frac{1}{2}$  to  $3\frac{1}{2}$  inches in length, collected at Gypsum, Colorado, from the Eagle River, by Jordan, Evermann, Fesler and Davis, Nos. 1305, 1308, 1309 and 1310, L. S. Jr. Univ. Mus. It has hitherto been confounded with *Cottus semiscaber*, which was taken in abundance at the same place, and recorded in their report as "*Cottus bairdii punctulatus*." The species is named for Miss Anna Louise Brown, artist of the Hopkins Laboratory.

We may here note that *Cottus philonips* is very doubtfully distinct from *Cottus beldingi*, the only difference we can find being in the deeper body of the latter, which is a widely distributed species. Of *Cottus philonips* only the types are yet known, the Alaskan specimens referred to it being quite distinct.

10. *Cottus shasta* Jordan & Starks, n. sp.

Head 3 to  $3\frac{1}{3}$  in body, depth  $4\frac{1}{2}$ . D. VIII or IX-17 or 18; A. 13 to 15; eye nearly 5 in head; maxillary  $2\frac{1}{5}$ ; third or fourth dorsal spine  $3\frac{3}{5}$ ; highest soft ray about 2; pectoral about  $1\frac{1}{10}$ ; caudal  $1\frac{1}{4}$ .

Body not much compressed; caudal peduncle rather wide, about equal to snout; mouth rather large, the maxillary reaching to posterior margin of pupil; teeth in a moderate band on jaws and vomer, in an exceedingly narrow band in front of palatines; interorbital space not much over half eye; upper preopercular spine short, not much hooked up and not very sharp; a shallow concave space between it and the second, scarcely a notch; the second small and sharp, the third but slightly developed. Pectoral reaching to below the fourth ray of soft dorsal; ventrals not reaching the vent; dorsals scarcely con

nected, the soft dorsal high, the highest rays equal to eye and snout; vent slightly nearer tail than tip of snout. Skin smooth, except a few scattered prickles under pectorals.

Color very dark brown or blackish; sides mottled; top of head uniform blackish; all the fins more or less mottled, ventrals white or dusky. The following is the fin formula of four specimens:

Dorsal IX-17; VIII-19; IX-17; IX-18.

Anal 14; 15; 15; 13.

Upper Sacramento Basin; here described from four specimens from McCloud River, Baird, Shasta county, California, about 4 inches in length. No. 4196, L. S. Jr. Univ. Mus. Collector, E. C. Starks.

The species is very close to *Cottus semiscaber*, but it has a longer anal.

11. **Tarandichthys filamentosus** (Gilbert). Plate xxviii.

*Icelinus filamentosus* Gilbert, Proc. U. S. Nat. Mus., 1890, 85. Off Santa Barbara Islands.

The section of *Icelinus* distinguished by the presence of filamentous dorsal spines, and the presence of bony plates behind the pectoral, represents a subgenus or genus distinct from *Icelinus*. This may be called *Tarandichthys*, Jordan & Evermann. The name (*Ταράνδος*, reindeer) alludes to the antler-like preopercular spine. The accompanying plate is from one of the type specimens of the type-species, *filamentosus*.

12. **Icelinus quadriseriatus** (Lockington). Plate xxix.

We present for comparison a figure of the type-species of *Icelinus* from a specimen dredged off the coast of California.

13. **Oligocottus borealis** Jordan & Snyder, n. sp.

Head  $3\frac{1}{2}$  in length; depth  $4\frac{1}{3}$ ; dorsal VIII or IX-16

or 17; anal 12 to 14; pectoral 14; orbit 4 in head; snout 4; maxillary  $2\frac{4}{5}$ ; highest dorsal spine 3; dorsal ray  $2\frac{1}{5}$ ; caudal ray  $1\frac{1}{2}$ ; first anal ray ♀  $1\frac{1}{2}$ , ♂ 3; ventrals  $1\frac{5}{8}$ ; caudal peduncle  $3\frac{1}{2}$ ; pectorals 3 in length.

Body compressed, elongate; back somewhat elevated, deepest below middle of spinous dorsal. Head almost as wide as long, tapering from behind to the somewhat pointed snout; profile of head rounded above, straight below; mouth terminal, nearly horizontal; maxillary extending to vertical through posterior part of pupil; lower jaw included; jaws, vomer and palatines with villiform teeth; snout as long as orbit; eye high in head; interorbital space narrower than width of orbit; its concavity angular; opercle with a triangular flap; angle of preopercle produced into a forked spine, which is covered with skin, except on the sharp points; prongs of preopercular spine half as long as orbit; nasal spines prominent; the long premaxillary processes form a sharp ridge between the latter; branchiostegal membranes forming a fold across the isthmus; gills  $3\frac{1}{2}$ , the slit behind the fourth arch much reduced; pseudobranchiæ present; gill-rakers represented by a few protuberances on the arch.

Skin smooth. Filaments on free end of maxillary, on inferior edge of preopercle, and from first dorsal to the bases of the pectoral fins; also a row of filaments extending along the supraorbital crest, over the back of the head and along the lateral line for about half the length of the body; the filaments are usually paired, *i. e.*, two grow from the same place. Anal papilla prominent. Large mucous pores are scattered about the top and sides of head; pores of lateral line 36 to 40.

Dorsal fins two, separate; first dorsal 4 in head and body, curving from distal end of first spine to posterior part of base; spines rather feeble; second dorsal 2 in

head and body, a little higher than first, its middle rays longest. Anal fin about  $3\frac{1}{4}$  in head and body; in the male the first and second rays longest, the third, fourth and fifth each a little shorter than the preceding one, the last shortest. In the female the first ray is the shortest. Caudal fin somewhat rounded. The pectoral rays below the sixth are ventrally free from the connecting membrane for a portion of their length. Ventral fins reaching to vent, in some specimens to anal.

Color usually reddish brown, varying to gray, intense green or crimson, according to surroundings, the colors developed in the presence of similarly colored algæ; dorsals, pectorals and caudal barred; anal sometimes barred; front of spinous dorsal with an ocellated black spot.

The types were collected in the tide pools at Neah Bay, Puget Sound, by Mr. E. C. Starks. Very many specimens are in the Leland Stanford Jr. University collection, No. 3396. Others were earlier sent to us by Henry St. Clair of Neah Bay. Still others were taken by Dr. Gilbert at Departure Bay, Vancouver Island.

This species is closely related to *Oligocottus maculosus*, with which it has been hitherto confounded. It is distinguished from the latter by having fewer filaments on the head and body, an ocellated spot on front of first dorsal, and by having the rays of the anal fin in the male all connected by membrane; the first ray of anal is much shorter and weaker in *borealis*.

14. *Ulca marmorata* (Bean). Plate xxx.

*Hemitripteris marmoratus* Bean, Proc. U. S. Nat. Mus., 1890, 43.  
Sitkalidak Island.

This species differs from *Hemitripteris* in the shorter first dorsal, which does not show the division found in the typical species of *Hemitripteris*. It is the type of the genus, *Ulca*, Jordan & Evermann. The specimen

figured, not a type, is from near Unalaska. Coll., C. H. Gilbert, on the Albatross.

Family GOBIIDÆ.

15. *Eleotris abacurus* Jordan & Gilbert, n. sp.

Head 3; depth  $4\frac{1}{3}$ . D. VI-9; A. I, 8; scales 51-20; eye 8 in head,  $2\frac{1}{3}$  in interorbital width; pectoral  $1\frac{1}{3}$ ; ventral  $1\frac{1}{2}$ ; highest dorsal ray 2; highest anal ray 2; caudal  $1\frac{1}{4}$ .

Body slender, compressed, the head depressed, becoming very narrow anteriorly, its width  $\frac{3}{5}$  its length; a notable depression above orbits, the premaxillary processes protruding before it; lower jaw the longer; maxillary reaching vertical behind pupil,  $2\frac{3}{5}$  in head. Teeth in jaws in narrow villiform bands, becoming a single series on sides of lower jaw; those of the outer and inner series in each jaw are somewhat enlarged, the largest being a single series in sides of lower jaw. Preopercular spine as usual in the genus. Scales smooth above and below, ctenoid on sides.

Color in spirits brown, lighter above and below; each scale on middle of sides with a dusky streak, these forming obscure lengthwise lines; back anteriorly with a few small black spots; under parts, including sides of head, very thickly punctulate with black; no dark stripes from orbit. Lips black; a dark streak from snout through eye to upper angle of preopercle; two dusky streaks from eye downwards and backwards across cheeks; a very conspicuous black blotch as large as eye in front of upper pectoral rays. Pectorals and ventrals transparent, dusky; vertical fins all barred with light and dark in fine pattern.

Coast of South Carolina; known from a single specimen, 4 inches long, No. 2009, L. S. Jr. Univ. Mus.; taken in the harbor of Charleston, by Dr. Gilbert.

This species agrees very well with Cope's account of *Culius amblyopsis*, but the eye is smaller and there is some difference in color, besides the remote habitat.

16. *Evermannia longipinnis* (Steindachner).

*Gobiosoma longipinnis* Steindachner, Ichth. Beitr., viii, 27, 1879.  
Las Animas Island, Gulf of California.

At my request, Dr. Steindachner has re-examined the types of his *Gobiosoma longipinnis*. He finds them completely scaleless, as originally described. The species cannot then be placed in the genus *Clevelandia*, as in Dr. Eigenmann's arrangement, but is nearest to *Evermannia*.

17. *Clevelandia rosæ* Jordan & Evermann, n. sp.

*Clevelandia longipinnis*, Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 1888, 73. San Diego. Not *Gobiosoma longipinne* Steindachner.

The species described from San Diego by Dr. and Mrs. Eigenmann, under the erroneous name of *Clevelandia longipinnis*, and made the type of the genus *Clevelandia*, must receive a new name. We suggest that of *Clevelandia rosæ*, in honor of Mrs. Rosa Smith Eigenmann, its discoverer.

Family URANOSCOPIDÆ.

18. *Kathetostoma averruncus* Jordan & Bollman. Plate xxxi.

*Kathetostoma averruncus* Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 163, southwest of Panama.

A figure of this interesting species of Star Gazer is here given from the original type.

Family DACTYLOSCOPIDÆ.

19. *Gillellus semicinctus* Gilbert. Plate xxxii.

*Gillellus semicinctus* Gilbert, Proc. U. S. Nat. Mus., 1890, 98. Gulf of California.

I present a figure of this interesting species from one of the types.

20. *Dactylagnus mundus* Gill. Plate xxxiii.

I present a figure of this species from a specimen obtained by Dr. Gilbert while with the Albatross. The genus is a valid one, well separated from *Doctyloscopus*.

## Family GOBIESOCIDÆ.

21. *Brysetæres pinniger* (Gilbert). Plate xxxiv.

*Gobiesox pinniger* Gilbert, Proc. U. S. Nat., 1890, 94. Puerto Refugio, Gulf of California.

This species is the type of a distinct genus, *Brysetæres* Jordan & Evermann, distinguished from *Gobiesox* by the long dorsal fin. The vertebræ are 26, as in *Gobiesox*. The plate here given is from one of the type specimens. The name βρόσχος, sea-urchin; ἑταῖρος, comrade, alludes to the brotherhood existing between the Cling-fishes and the Sea-urchins in the rock pools.

22. *Arbaciosa humeralis* (Gilbert). Plate xxxv.

*Gobiesox humeralis* Gilbert, Proc. U. S. Nat. Mus., 1890, 95. Puerto Refugio.

This species, with its allies *zebra*, *eos*, *rhesodon*, etc., differs from *Gobiesox* in the serrated teeth. It may be made the type of a distinct genus, *Arbaciosa* Jordan & Evermann.

The name is given in allusion to the close association in the rock pools between the Sea-urchins and the species of this genus. This relation is especially close between the Sea-urchin, *Arbacia stellata* and *Arbaciosa zebra*.

23. *Arbaciosa rhesodon* (Rosa Smith). Plate xxxvi.

I present a figure of this interesting species from a specimen from San Diego.

24. *Arbaciosa eos* (Jordan & Gilbert). Plate xxxvii.

I here present a figure of a specimen from Mazatlan.

25. *Rimicola muscarum* (Meek & Pierson).

*Gobiesox muscarum* Meek & Pierson, Proc. Cal. Ac. Sci., 1895, with plate. Monterey.

This species is distinguished from *Gobiesox* by the narrow body and very small dorsal and anal fins. It may be regarded as the type of a new genus, *Rimicola* Jordan & Evermann. To the same genus, *Gobiesox eigenmanni* Gilbert may be referred. *Rimicola muscarum* has been well figured by Meek & Pierson.

26. *Rimicola eigenmanni* Gilbert. Plate xxxii.

I present a figure of the type of this species from Todos Santos Bay.

## Family BATRACHOIDIDÆ.

27. *Thalassophryne dowi* Jordan & Gilbert. Plate xxxviii.

*Thalassophryne dowi* Jordan & Gilbert, Proc. U. S. Nat. Mus., 1887, 388. Panama.

I present a figure of this interesting species, taken from a specimen from Panama, larger than the original type.

I may notice that *Batrachus* Bloch & Schneider, 1801, is a synonym of *Batrachoides* Lacépède, 1800, and cannot be used as the name of a distinct genus. None of the naked Toad-fishes were known to Schneider. The oldest generic term available for them is that of *Opsanus* Rafinesque, *Opsanus cerapalus* is identical with *Batrachus tau*, which must stand as *Opsanus tau*.

## Family BLENNIIDÆ.

28. *Starksia cremnobates* (Gilbert).

*Labrisomus cremnobates* Gilbert, Proc. U. S. Nat. Mus., 1890, 100. Gulf of California.

This pretty species seems to be the type of a distinct genus, *Starksia* Jordan & Evermann, distinguished from *Labrisomus* by the large scales, presence of palatine teeth, the short, soft dorsal and the absence of the comb of

nuchal filaments. It is named for Mr. Edwin Chapin Starks, in recognition of his work on the fishes of the Pacific Coast.

29. *Exerpes asper* (Jenkins & Evermann).

*Auchenopterus asper* Jenkins & Evermann, Proc. U. S. Nat. Mus., 1888, 154. Guaymas.

The widely separated and ribbon-like first dorsal fin, formed of three close set spines, may distinguish *asper* generically from the other species of *Auchenopterus*. The genus *Exerpes* Jordan & Evermann, based on it, is further distinguished by the long, sharp snout, and the long ventrals. The species has been well figured by Jenkins & Evermann. (Proc. U. S. Nat. Mus., 1891; plate II.)

30. *Chasmodes jenkinsi* Jordan & Evermann, n. sp.  
Plate xxxix.

*Hypsoblennius striatus* Evermann & Jenkins, Proc. U. S. Nat. Mus., 1891, 163, Guaymas, not of Steindachner.

Head  $3\frac{1}{3}$  (4 in total); depth 4 (5). D. XII, 17; A. 18 or 19; eye 4 to 5 in head.

Body more robust than in related species, resembling *Hypsoblennius*; head large, gently rounded in profile, the snout steep, 4 in head; interorbital space narrow, grooved; orbital tentacle (male) much as in *Hypsoblennius gilberti*, about 3 in head, branched, the branches usually 4; mouth much larger than in *Hypsoblennius*, the maxillary  $2\frac{3}{4}$  to 3 in head, reaching to below posterior margin of eye; teeth even, comb-like; gill opening 2 in head, extending downwards nearly to lower edge of pectoral, much larger than in *Chasmodes saburræ*. Dorsal little notched, the spines slender,  $2\frac{1}{2}$  in head, the rays a little higher; anal lower, the rays  $3\frac{1}{2}$  to 4 in head; pectorals reaching anal,  $1\frac{1}{3}$  in head; ventrals  $2\frac{1}{4}$ . Dorsal and anal free from caudal.

Color in life, according to Evermann & Jenkins, yellowish; five quadrate spots of darker extending from dorsal to a line drawn from middle of eye to lower base of caudal, the anterior one above tip of pectoral; median line of side with a more or less distinct series of small spots; a short dark vertical line behind the eye; a dark blotch in front of origin of dorsal fin and another on humeral region; under side of head with two ill-defined bands of dark; dorsal fin more or less speckled with black, the anal with a narrow white border above which is a broader band of deep brown.

Six specimens, the largest about 3 inches long, were obtained at Guaymas, Sonora, by Dr. Evermann and Dr. Jenkins in 1887. One of these, No. 412, L. S. Jr. University Mus., examined by us, is the type of the present description.

The large mouth distinguishes this species at once from *Hypsoblennius striatus*, with which it has been identified. The species is intermediate between typical *Chasmodes* and *Hypsoblennius*, and its discovery may make it necessary to merge the latter in *Chasmodes*.

31. *Runula azalea* Jordan & Bollman. Plate xxxvii.

Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 171. Indefatigable Island.

I present a plate taken from one of the types of this interesting little Blenny.

32. *Lucioblennius alepidotus* Gilbert. Plate xxxvii.

Gilbert, Proc. U. S. Nat. Mus., 1890, 103. Gulf of California.

The genus *Lucioblennius* is very close to *Chænopsis* of the West Indies, and belongs to the *Chænopsinae*. It is not possible to separate this group, as a family, from the *Blenniidae* until the various intermediate subfamilies, *Pholidichthyinae*, *Pseudoblenniinae*, *Emblemariinae* and *Ophio-*

*blenniine* are better known. The accompanying plate is from one of the types.

Family LYCODAPODIDÆ.

33. *Lycodapus fierasfer* Gilbert. Plate xxxiii.

*Lycodapus fierasfer* Gilbert, Proc. U. S. Nat. Mus., 1890, 108. Station 2980, etc.

The genus *Lycodapus* cannot be retained among the *Zoarcidæ*, as its general relations are with *Fierasfer* rather than *Lycodes*. It seems to represent a distinct family (*Lycodapodidæ*) distinguished from *Fierasfer* by the normal position of the vent, which is not at the throat. Its gill membranes are separate and free from the isthmus. The accompanying plate is taken from one of the types.

Family BROTULIDÆ.

34. *Bregmaceros macclellandi* (Thompson).

*Bregmaceros macclellandi* Thompson, Charlesworth's Mag. Nat. Hist., 1840. India.

*Bregmaceros bathymaster* Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 178. Off Coast of Colombia, near Panama.

Two additional specimens of the species called *Bregmaceros bathymaster* have been found since the species was first described. They are from the same locality, having been mislaid in the removal of the collection. These are in better condition than the first and seem to agree fully with the accounts of *B. macclellandi*.

The genus *Bregmaceros* has the hypercoracoid perforate, as in the *Brotulidæ*. It cannot therefore be placed among the *Gadidæ*, but belongs very near the *Brotulidæ*, if it be not a genuine member of that family.

The remainder of this paper consists of notes by Mr. Frank Cramer on some new or little-known species of *Sebastodes*. This matter is supplementary to Mr. Cra-

mer's recent paper on the Cranial Characters of *Sebastes*, Proc. Cal. Acad. Sci., 1895, pp. 573 to 611.

Family SCORPÆNIDÆ.

35. *Sebastes ciliatus* (Tilesius). Plate xl.

Head  $3\frac{1}{4}$ , depth 3 to  $3\frac{1}{4}$ ; D. XIII, 16; A. III, 8; P. 18 to 19. Transverse (oblique) rows of scales 46 to 47 (+3 or 4 on caudal). Pores 46 to 47. Body compressed, deep, its width over the base of the pectorals about 2 in the depth. Dorsal outline descending rapidly backward in a slight curve from origin of first dorsal to end of second dorsal. Depth of peduncle more than 3 in depth of body. Head compressed, profile steep and nearly straight. Eye moderate, orbit circular,  $3\frac{2}{3}$  in head, a little longer than snout, its posterior rim at about the middle of length of head. Interorbital space strongly convex, its width a little less than orbit,  $3\frac{6}{7}$  to 4 in head. Nasal spines small; cranial ridges and spines all obsolete, except the parietal; parietal ridges very slightly developed, with a minute point or none, covered with scales. Mouth moderate, quite oblique; tip of upper jaw on a level with center of eye; maxillary  $2\frac{1}{3}$  in head, its posterior end reaching about to vertical from posterior edge of pupil. Lower jaw a little projecting, with a slight symphyseal knob. Very narrow bands of teeth on jaws, vomer and palatines. Preorbital moderate, its lower edge scarcely at all indented or entirely continuous, spineless. Suborbital stay scarcely visible. Preopercular spines small, the three upper directed backward and slightly diverging, nearly equidistant and of equal size, the two lower minute or obsolescent. Opercular spines small, without visible ridges. Gill-rakers slender, 2 in orbit, 23 to 24 on anterior limb of first arch. Dorsal fin rather low, the spines delicate, the 5th longest,  $2\frac{1}{4}$  to  $2\frac{1}{2}$  in head, the 2d about equal to

the 11th, the 12th about  $1\frac{1}{3}$  in the 13th; the membrane rather deeply incised anteriorly, and reaching about half way up the 13th spine. Soft rays about equal to the spines. Caudal fin slightly lunate, its length about  $1\frac{1}{2}$  in head. Second and third anal spines about equal in length, the former a little stronger,  $1\frac{1}{3}$  in the soft rays. Pectorals reaching very nearly to vent, a little less than head,  $3\frac{1}{2}$  in body, their base nearly 3 in their length, the median rays longest. Ventrals not reaching vent, about  $1\frac{1}{3}$  in pectorals. Scales on body, opercles and interorbital space strongly ctenoid; those on mandibles, maxillaries and most of those on cheeks cycloid; preorbital and snout with minute scales. Accessory scales few. Color, in alcohol, dark reddish brown, mottled with lighter; top of head nearly black, a dark stripe on edge of lower jaw, another on maxillary; a dark brown band from preorbital downward and backward to posterior edge of preopercle; a broader band from posterior rim of orbit downward and backward across preopercle and opercle. Fins all dusky, the dorsals somewhat mottled. Peritoneum black. The following description of the color is added from Jordan & Gilbert's Synopsis: "Blackish green, sides rather pale, much mixed with darker; dark shades from eye backward; a black streak on maxillary."

Coast of Alaska, rare; not noticed south of Kodiak when the specimens here described were taken. No other specimens are known, except those of Pallas still preserved in the museum at Berlin.

The above description is taken from three specimens  $5\frac{1}{4}$  to  $5\frac{3}{4}$  inches long, in the possession of the Alaska Commercial Company, one of them since presented to Leland Stanford Jr. University. The following is the synonymy of the species: *Epinephelus ciliatus* Tilesius, Mém. Acad. Sci. St. Petersb., iv, 474, 1810, Aleutian

Islands; *Perca variabilis* Pallas, Zoogr. Rosso-Asiat., iii, 241, 1811, Aleutian Islands, type; red specimens of *Sebastodes introniger* included as the summer coloration; *Sebastodes variabilis* Cuvier & Valenciennes, Hist. Nat. des Poiss., iv, 347; Günther, Cat. Fishes, ii, 99; *Sebastodes ciliatus* Jordan & Gilbert, Synopsis, 658, 1883.

36. *Sebastodes hopkinsi* Cramer. Plate xli.

*Sebastodes hopkinsi* Cramer, Proc. Cal. Acad. Sci., 1895, 594. Monterey.

Head 3, depth  $3\frac{2}{5}$ ; D. XIII, 14; A. III, 7. Transverse rows of scales (midway between lateral line and base of dorsal fin) about 52; pores about 51. Body compressed, not very deep, profile steep, depth of caudal peduncle a little less than orbit. Head compressed, eye large, orbit  $3\frac{1}{2}$  in head. Interorbital space evenly convex,  $4\frac{1}{2}$  in head; cranial ridges nearly obsolete; parietal ridges very low but broad, brown. Nasal spines small, far apart; preocular spines rather strong, triangular, supraocular and postocular usually present, very minute, tympanic and parietal spines sometimes present. Mouth moderate, oblique; maxillary very little more than 3 in head, nearly reaching vertical from center of pupil, its posterior end very broad, two in orbit. Lower jaw much projecting, with a prominent, forward directed symphyseal knob, which enters the profile. Narrow bands of teeth on jaws, vomer and palatines. Preorbital rather narrow, its lower margin lobate, with sometimes a small spine. Preopercular spines flat, sharp, nearly equidistant, all directed backward, the 2d longest, 4th and 5th minute. Opercular spines flat, sharp, somewhat diverging, the upper considerably larger; spines on shoulder weak. Gill-rakers 29 on anterior limb of first arch, long, slender, very little more than two in orbit.

Dorsal spines slender, low, the 4th longest,  $2\frac{3}{5}$  in head,

the 12th  $\frac{2}{3}$  as long as longest; soft rays equal to longest spines. Only a slight notch between the dorsals. Caudal lunate,  $1\frac{2}{3}$  in head; second anal spine stronger and considerably longer than third, longer than soft rays, longer than longest dorsal spine, very little more than two in head. Pectorals reaching beyond ventrals but not to vent, a little less than head,  $3\frac{1}{2}$  in body; their base narrow, equal to orbit, the lower rays not thickened. Scales rather small, everywhere strongly ctenoid, accessory scales not very numerous; preorbital, snout, maxillaries, mandible and branchiostegal rays scaled; all the fin rays more or less scaly. Color much as in *Sebastodes ovalis*, but with dark blotches and no dark specks. Dark olivaceous, tinged with reddish, especially below; a large, irregular dark blotch under soft dorsal, crossing lateral line; a smaller one on lateral line below posterior part of spinous dorsal; top of head and anterior part of back to about 9th dorsal spine nearly uniformly dark to below lateral line; two indefinite dark bands from behind orbit across preopercle and opercle; lips black. Dorsal fin olivaceous, spinous dorsal dark-edged, soft dorsal darker at base; caudal and pectorals olivaceous, axils dark, ventrals yellowish, anal pale; no small round black spots anywhere. Peritoneum black. Bones of skull thin, cranial ridges nearly obsolete, parietal bones meeting, interorbital space somewhat convex,  $3\frac{1}{3}$  in base of skull, a slight depression on each side of a sharp, narrow median ridge, and another just within each supraocular ridge; ventral process of basisphenoid rudimentary, mesethmoid processes compressed, not elevated; base of skull very strongly curved. Closely related to *Sebastodes ovalis*. Types  $7\frac{3}{4}$  inches long. No. 2282, L. S. Jr. Univ.

This species is thus far known from Monterey Bay, California, whence the six specimens before us were

taken. It is named for Mr. Timothy Hopkins, founder of the Hopkins Seaside Laboratory at Monterey. Since this description was written, numerous additional examples have been secured. It is evidently not rare about Monterey.

**37. *Sebastes eigenmanni* Cramer, n. sp. Plate xlii.**

Head  $2\frac{7}{10}$ ; depth  $2\frac{5}{6}$ . D. VIII, 14; A. III, 8; P. 18 ( $\frac{9}{8}$ ); Lat. 1; pores 41 (+2 on base of caudal); transverse rows of scales 41.

Body compressed, its width (behind opercles) about  $2\frac{1}{2}$  in its depth. Greatest width of head  $2\frac{2}{5}$  in its length. Profile steep; interorbital space flat,  $5\frac{1}{7}$  in head; supraocular and parietal ridges quite well developed, the former flat, the latter diverging backward. Preocular, supraocular, postocular, tympanic and parietal spines present, not very large, but sharp; a curved shallow groove at each side of the interorbital space inside of the supraocular ridges. Orbit large, nearly circular,  $3\frac{1}{4}$  in head, its upper rim on a level with the profile. Snout short, about equal to interorbital width; preorbital moderate, with two small sharp spines directed downward and backward; maxillary  $2\frac{2}{5}$  in head, reaching a little beyond vertical from posterior edge of pupil; mandible projecting somewhat, with a moderate symphyseal knob. The uppermost preopercular spine small, directed a little upward, the second longest, horizontal, the fourth and fifth small, but evident; upper opercular spine slender and sharp, the lower shorter. Gill-rakers long and slender, about  $2\frac{1}{3}$  in the orbit, 23 on horizontal limb of first arch. Scales rough, ctenoid, those on opercles, cheeks and interorbital space and snout somewhat rough; those on maxillary, mandible and breast mostly cycloid; very few accessory scales. Spines of first dorsal moderate, the

fourth longest,  $2\frac{1}{4}$  in head, the fifth, sixth and seventh nearly equal, the twelfth  $2\frac{1}{4}$  in the fourth; the membrane deeply incised; longest dorsal ray about equal to longest spine. Anal spines graduated; the second nearly as long as and but little stronger than third,  $2\frac{3}{5}$  in head,  $1\frac{1}{3}$  in the soft rays. Caudal truncate, or a little rounded (the rays somewhat injured). Base of pectorals 4 in head, the nine lower rays simple, the middle rays longest, reaching a little beyond vent,  $3\frac{1}{5}$  in length of body.

Ventrals reaching vent.

Color in alcohol: Reddish-brown; pale below; dorsals and pectorals dusky; membranes of spinous dorsal black-edged, and tips of ventrals blackish. Peritoneum white, with a few black specks.

One specimen, 7 inches long, taken at Monterey, California, by Dr. Wilbur W. Thoburn; No. 4046, L. S. Jr. Univ. Mus.

It is named for Dr. Carl H. Eigenmann, of the University of Indiana, in recognition of his work on the genus *Sebastodes*. The species is nearest to *Sebastodes ovalis*, but the mouth is larger and the color different.

### 38. *Sebastodes darwini* Cramer, n. sp.

?*Sebastès oculata* Jenyns, Voyage H. M. S. Beagle, Zool. Fish. No. ii, part iv, 37, 1840, Valparaiso.

Closely allied to *Sebastodes rosaceus*. Spines similar in number, but a trifle higher; upper spines on preopercle longest. Gill-rakers slender,  $x+18$ , nearly as long as pupil. Jaws subequal. Pectoral short,  $1\frac{1}{3}$  in head, the lower rays thickened; second anal spine long, curved. A. III, 6. Compared with a specimen of *S. rosaceus* of the same size, the snout is blunter in *S. darwini*, the cranial ridges are a shade higher; the pectoral is shorter, reaching only to vent (while in *S. rosaceus* it reaches to second anal spine; second anal spine much longer than

third (subequal in *S. rosaceus*); dorsal spines lower, 3 in head ( $2\frac{2}{3}$  in *rosaceus*). Scales similar. Mexillones, Peru.

Here described from MS. notes of Dr. D. S. Jordan, taken from the type in Mus. Comp. Zool., Cambridge, Mass.

Jenyns described a specimen from Valparaiso as the *Sebastodes oculus* of Cuvier and Valenciennes; but pointed out distinctions between the two, which with later knowledge of related species prove beyond a doubt that it is distinct. This specimen probably belongs to *Sebastodes darwini*. Jenyns also mentions a figure of another species from Valparaiso, very distinct from the others in having the spines of the head less developed. More than 50 species of the genus have been described from the north temperate waters of the Pacific Coast of America, and it is not improbable that the species of this genus will be found numerous in the temperate waters of the South American Coast.

**39. *Sebastodes gilberti* Cramer, n. sp. Plate xliii.**

Head  $2\frac{7}{10}$ ; depth  $2\frac{3}{4}$  to 3. D. XIII, 13. A. III, 6. P. 17; transverse (oblique) rows of scales 40 to 42; lat. l. (pores) about 39 to 42. Body somewhat compressed, its width over the base of the pectorals nearly two in the depth. Head compressed, profile steep, nearly straight. Preocular, postocular, tympanic and parietal spines and ridges present, all rather delicate, these spines somewhat appressed, the parietal ridges diverging backward in slight curves. Interorbital space  $1\frac{1}{2}$  in orbit, a little concave, with a pair of low ridges and a shallow median groove between them. Orbit high up, nearly circular, 4 in head, its posterior rim at about the middle of length of head. Preorbital scarcely lobate on its ventral margin, usually with one short triangular spine posteriorly. Sub-

orbital stay not visible externally. Preopercular spines all directed backward, the two uppermost closer together, the two lowermost weak. Opercular spines rather small, sharp, without visible ridges. Mouth nearly horizontal, the tip of the upper jaw nearly on a level with the lower rim of the orbit. Maxillary  $2\frac{2}{7}$  in head, its posterior end reaching about to vertical from posterior rim of orbit. Lower jaw very slightly projecting, with a slight symphyseal knob. Teeth on jaws, vomer and palatines, the bands on the latter narrow. Gill-rakers rather slender, 2 to 3 in orbit, 23 on anterior limb of first arch.

Fourth dorsal spine highest,  $1\frac{1}{3}$  in head; membrane of first dorsal very deeply incised, reaching only  $\frac{1}{4}$  of the way up on the anterior side of the 3d, and about  $\frac{1}{3}$  of the way up on the 4th spine, nearly to the tip of the 12th, and about half way up on the 13th spine; soft rays lower than the spines, about  $1\frac{1}{2}$  in the longest spine. Caudal fin truncate, with 11 to 12 full length rays, about  $1\frac{2}{3}$  in head. Second anal spine longer and much stronger than third,  $2\frac{2}{5}$  in head,  $1\frac{1}{5}$  in the soft rays. Pectoral fin reaching to or a little beyond vent,  $3\frac{1}{4}$  in length of body, the median rays longest, the 8 lower rays unbranched and thickened; base of fin 3 in its length. Ventrals reaching not quite to vent, the spine about equal to the 3d anal spine.

Scales rather small, those of body, cheeks and inter-orbital space all ctenoid, those on breast cycloid; maxillary with minute scales, lower jaw and top of snout naked. Accessory scales few, some of them ctenoid.

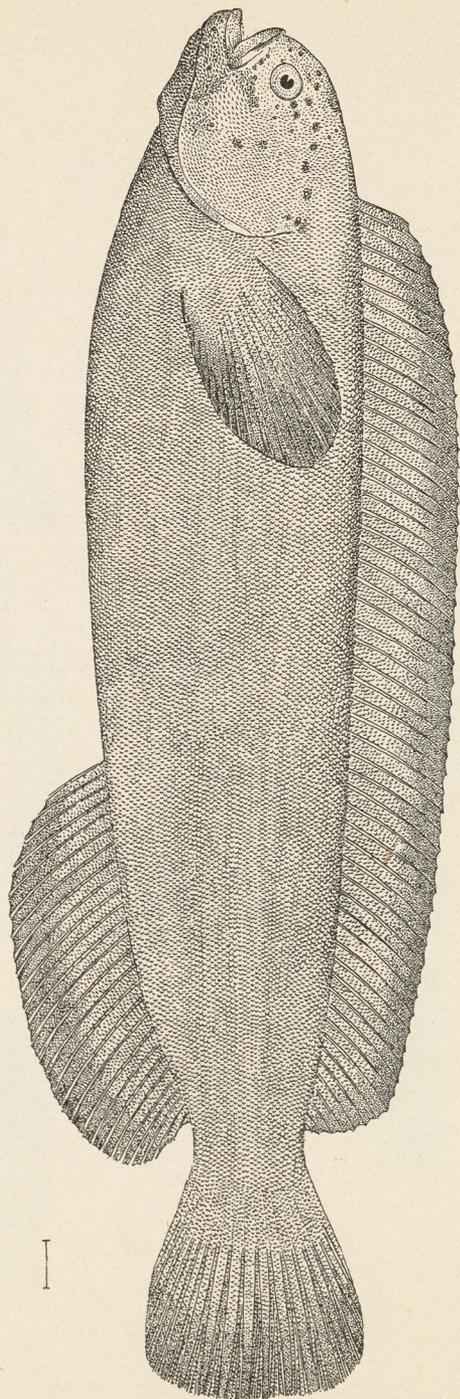
Color: Head blackish above, lips dusky, a dark band from front of orbit forward along side of snout; a dark stripe on maxillary; a blackish or olivaceous band from preorbital backward and downward across preopercle; another broader band from posterior

rim of orbit across preopercle and lower end of subopercle; a dark blotch on opercle; a blackish area in front of dorsal and under first and second spines, extending with interruptions to axils of pectorals and on to the base of the fin, and downward and backward in a narrow broken band toward vent; another band from below 6th and 7th dorsal spines downward and backward nearly to origin of anal; a third short one from below 9th and 10th spines to lateral line; a broad one under soft dorsal extending below lateral line, and another across peduncle; all these dark areas extend up on the dorsal fin; their outlines are not sharply defined, and they as well as the lighter areas of the body are mottled with scattered, much darker spots; the lighter areas were in the fresh state a dull brick red, becoming lighter below. Dorsal membrane blackish between 1st and 3d, and between 5th and 11th spines. Soft dorsal spotted with blackish anteriorly; membrane of caudal dusky, the dark much broken into spots; anal and ventrals dusky. Pectorals with a broad, transverse, dark, spotted band near base, and a transverse dusky area with darker spots on distal half. Fins in life more or less tinged with the reddish color. Peritoneum white. Types, three specimens  $7\frac{1}{2}$ ,  $8\frac{1}{4}$  and  $8\frac{1}{2}$  inches long (No. 3893, L. S. Jr. Univ.), from Monterey, found in San Francisco market. Many others have been since obtained from Monterey, where it is common. The species is an ally of *Sebastodes carnatus* and *Sebastodes chrysomelas*. It had been previously confounded with the young of *Sebastodes carnatus*. It seems to reach a smaller size than any of the related forms.

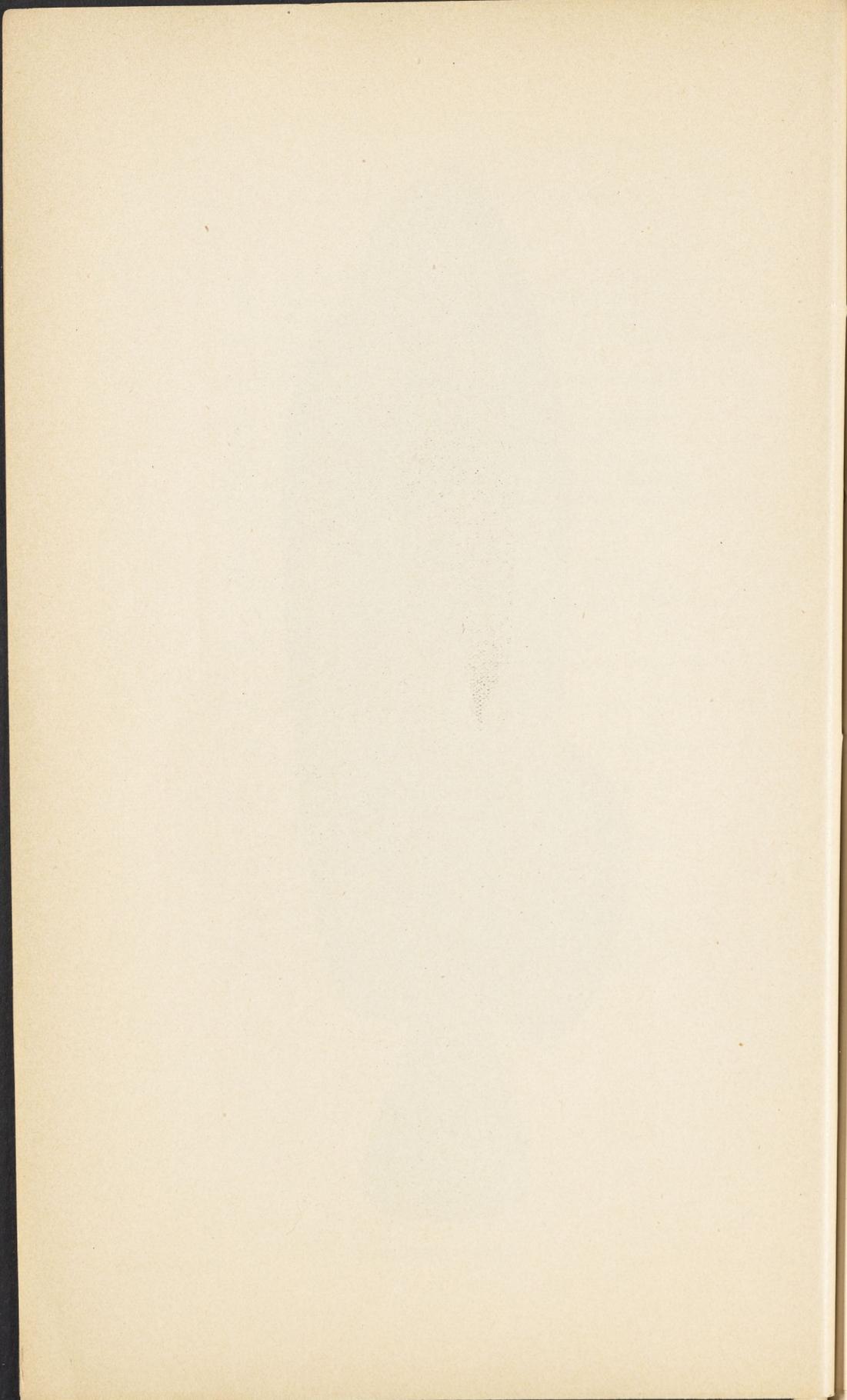
This species is named from Prof. Charles Henry Gilbert, of Leland Stanford Junior University.

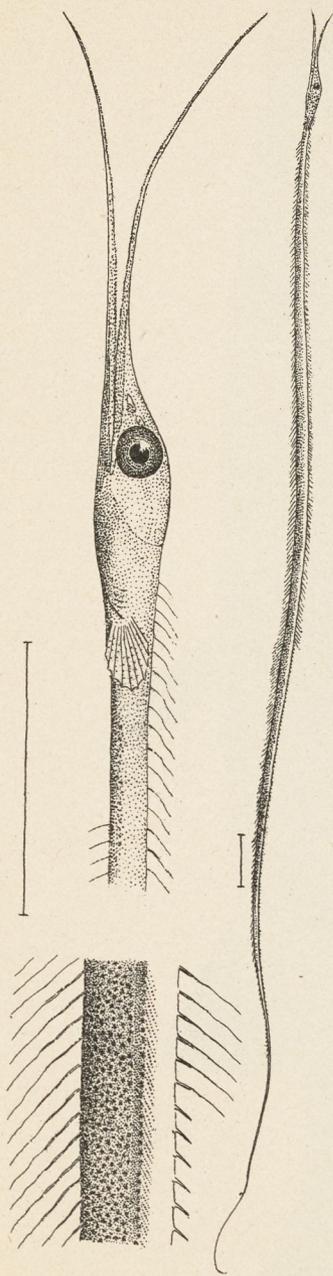
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- XXII. *Salmo gairdneri crescentis*: type. Lake Crescent, Washington.
- XXIII. *Salmo gairdneri beardsleei*: type. Lake Crescent, Washington.
- XXIV. *Xenocys jessiae*: type. Charles Island, Galapagos.
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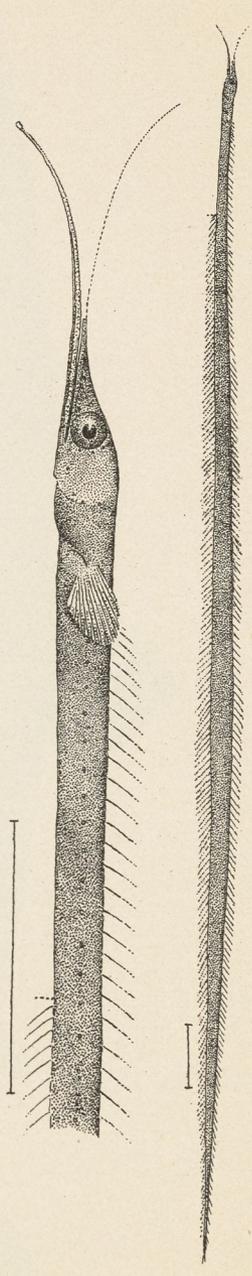
ZAPRORA SILENUS





NEMICHTHYS AVOCETTA

ANNA L. ERICSON, DEL.



AVOCETTINA GILLII

LITH. BRITTON & REY, S.F.

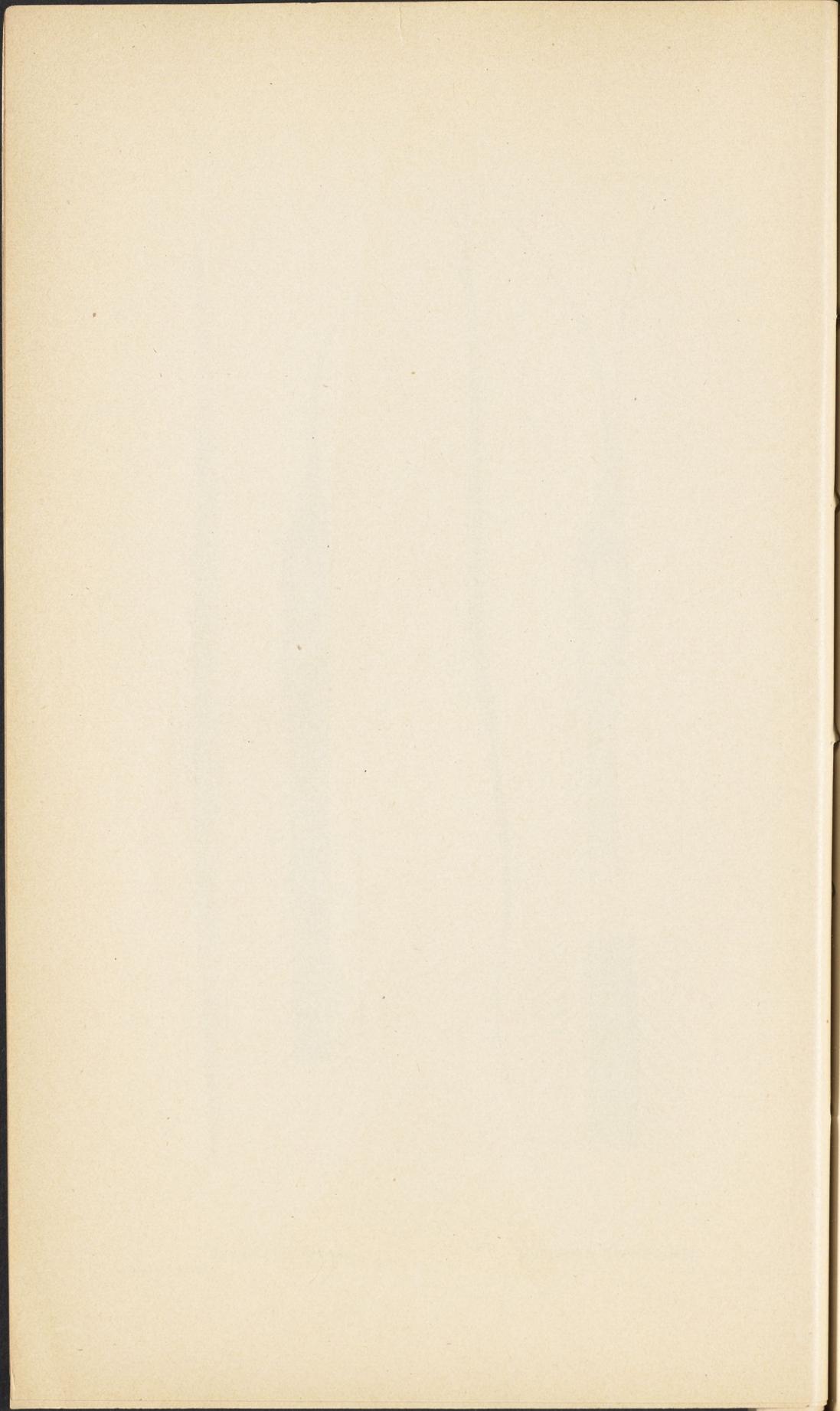
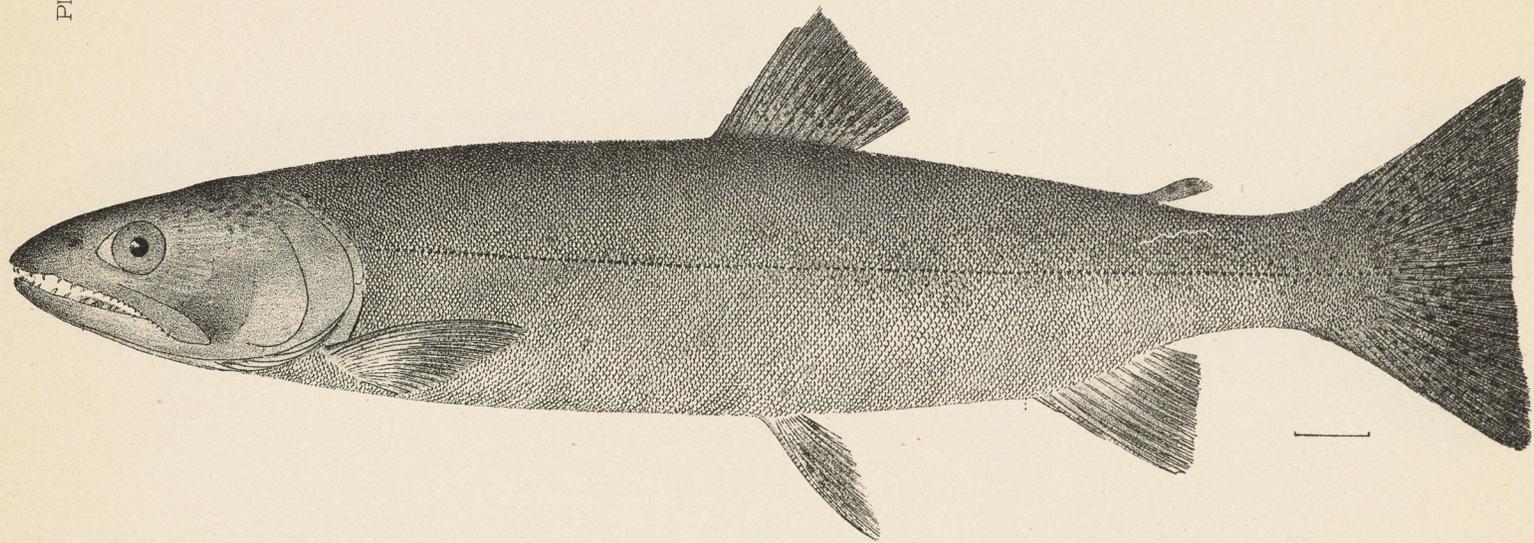


PLATE XXII.



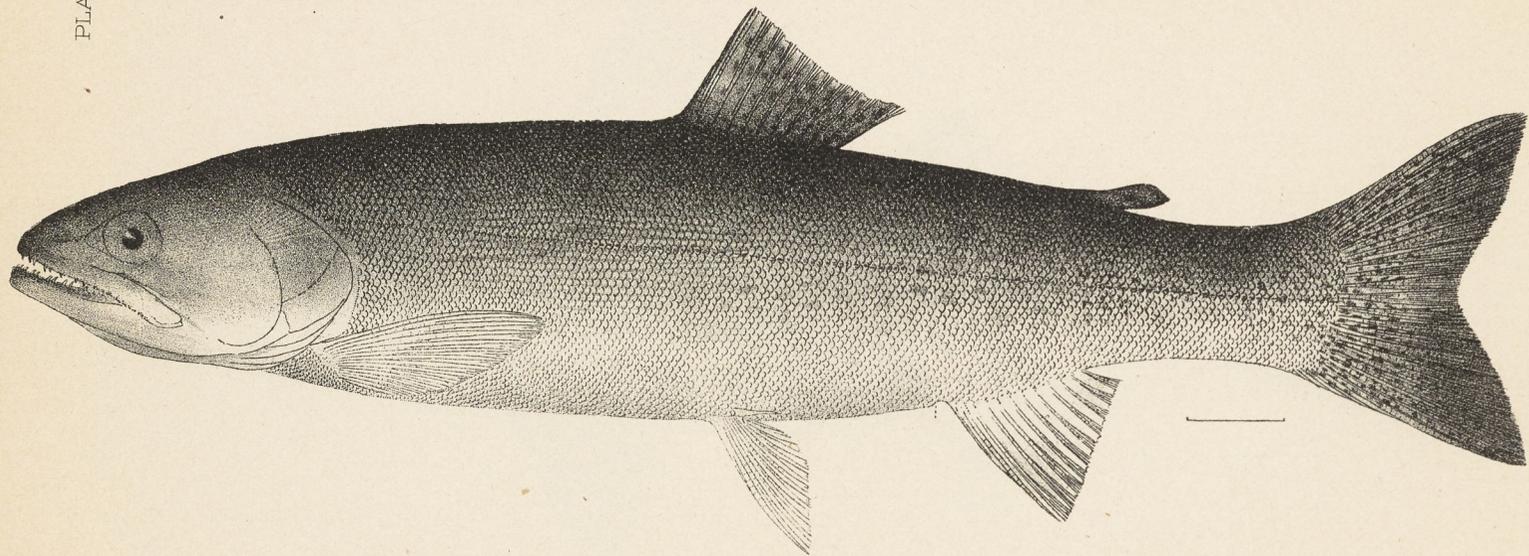
*ANNA L. BROWN, DEL.*

SALMO GAIRDNERI CRESCENTIS

*LITH. BRITTON & REY, SF.*



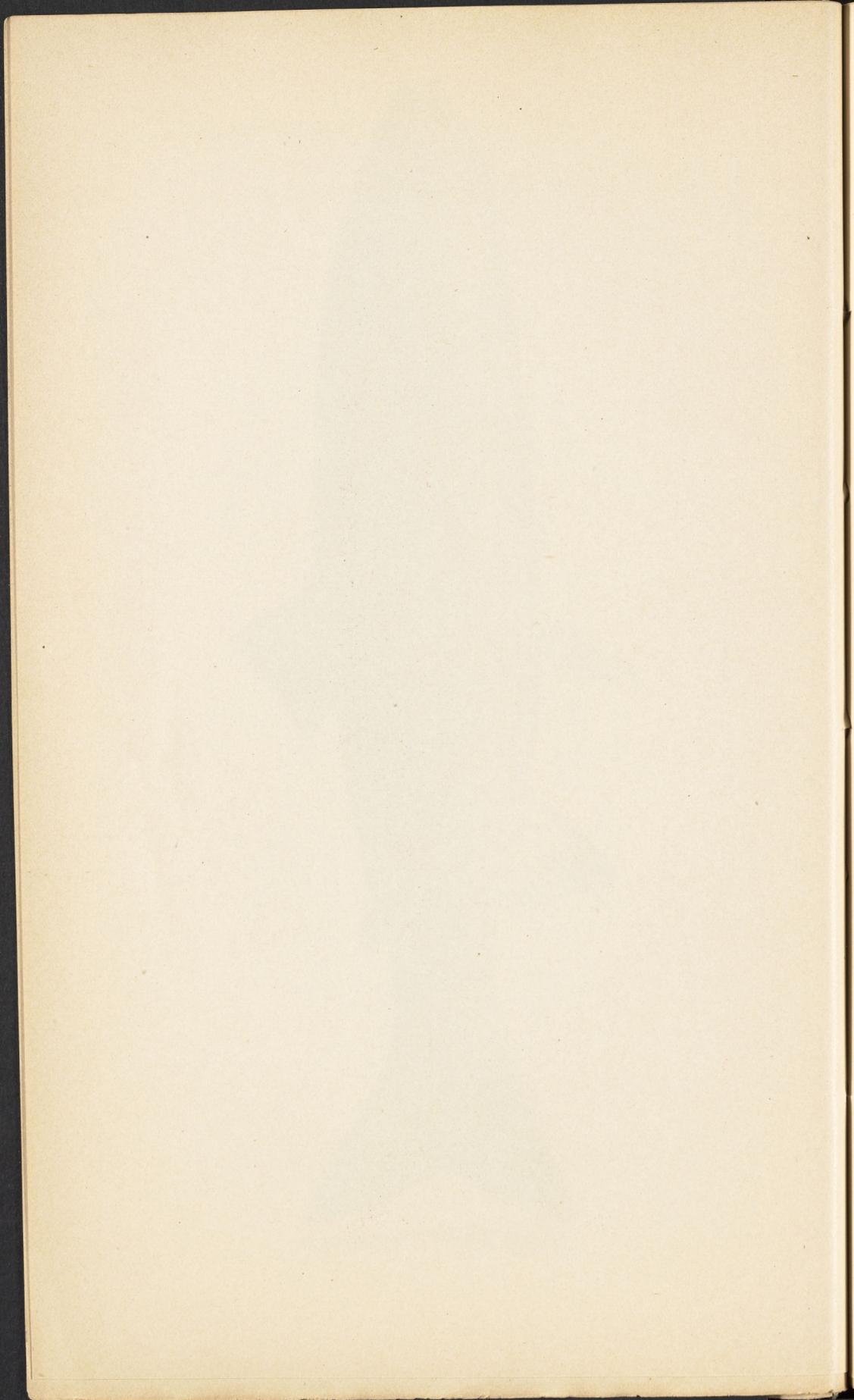
PLATE XXIII.

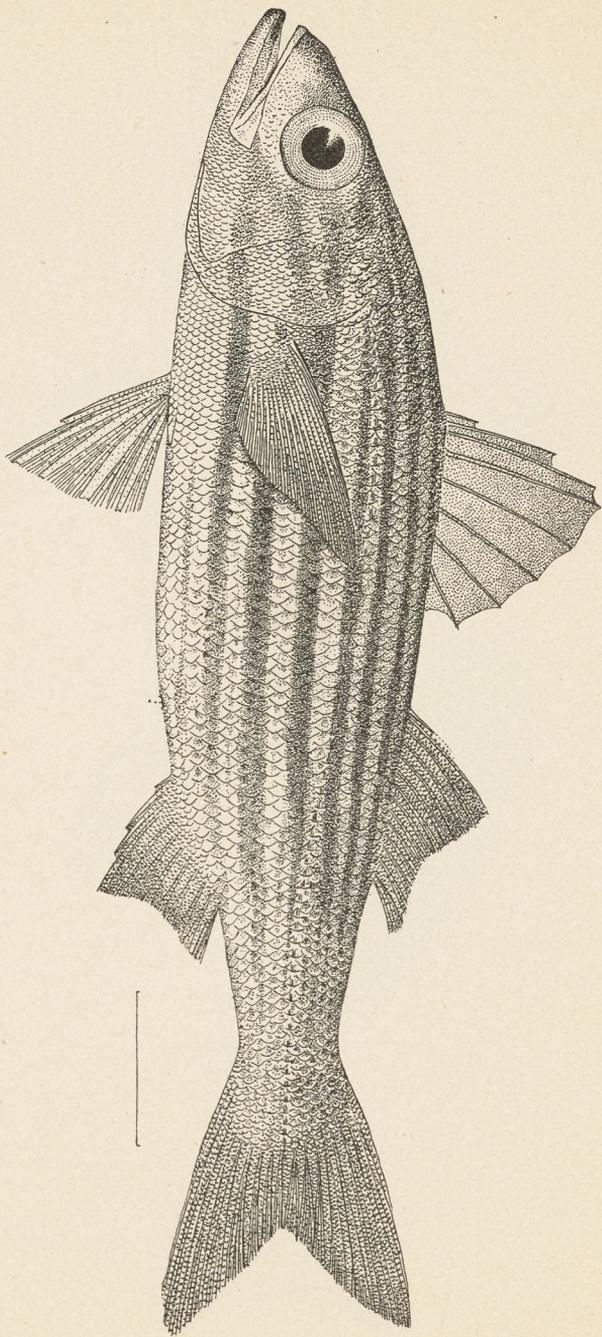


*ANITA L. BROWN, DEL.*

SALMO GAIRDNERI BEARDSLEEI

*LITH. BRITTON & PEST, SF.*

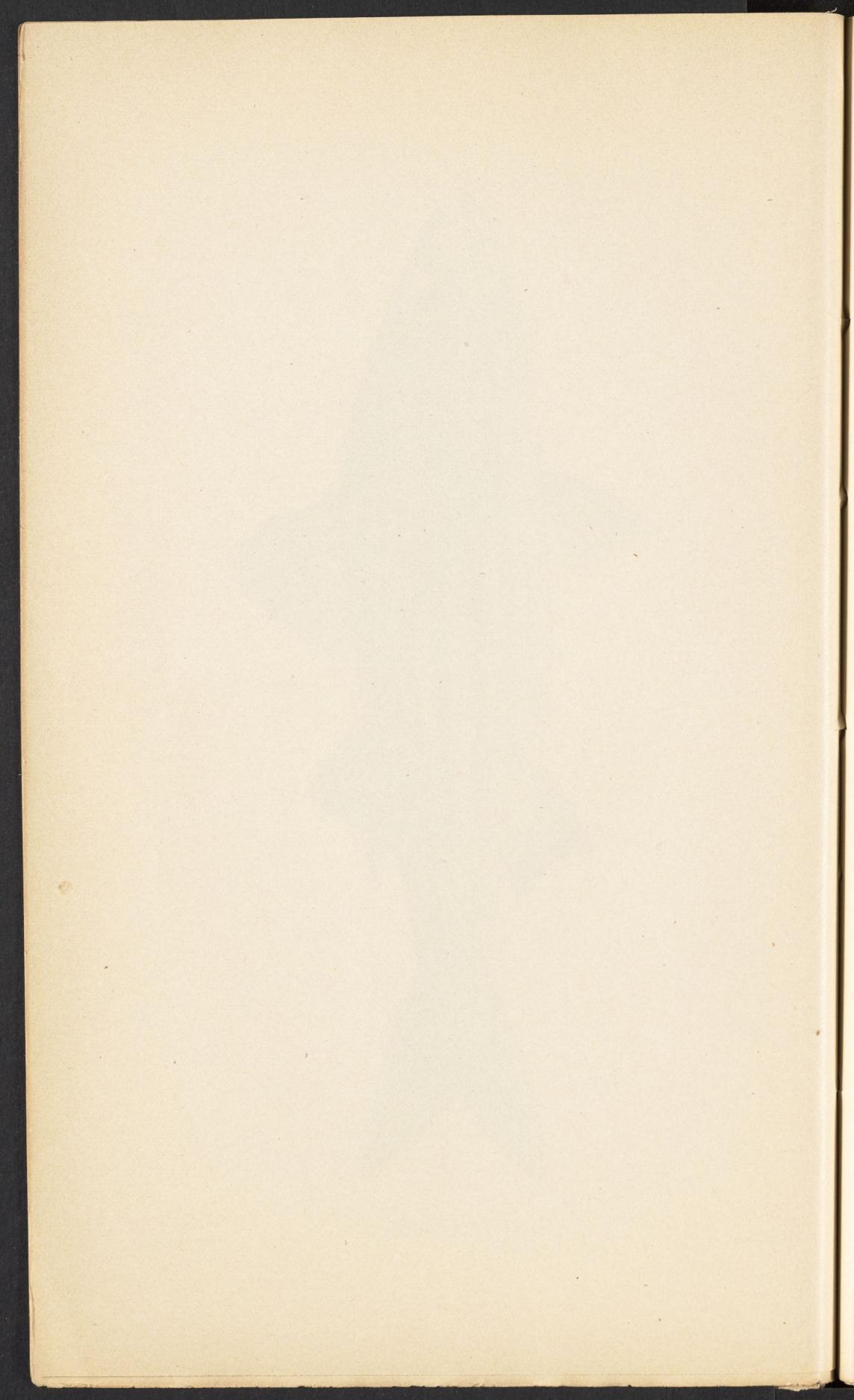


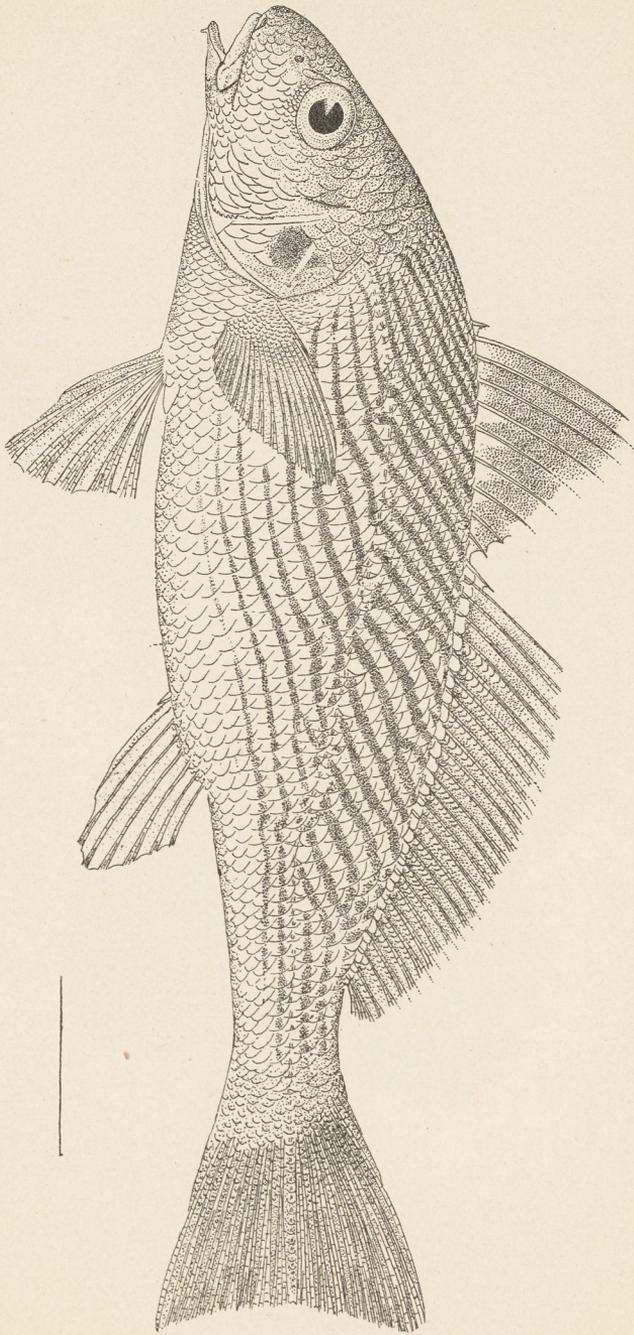


XENOCYS JESSIÆ

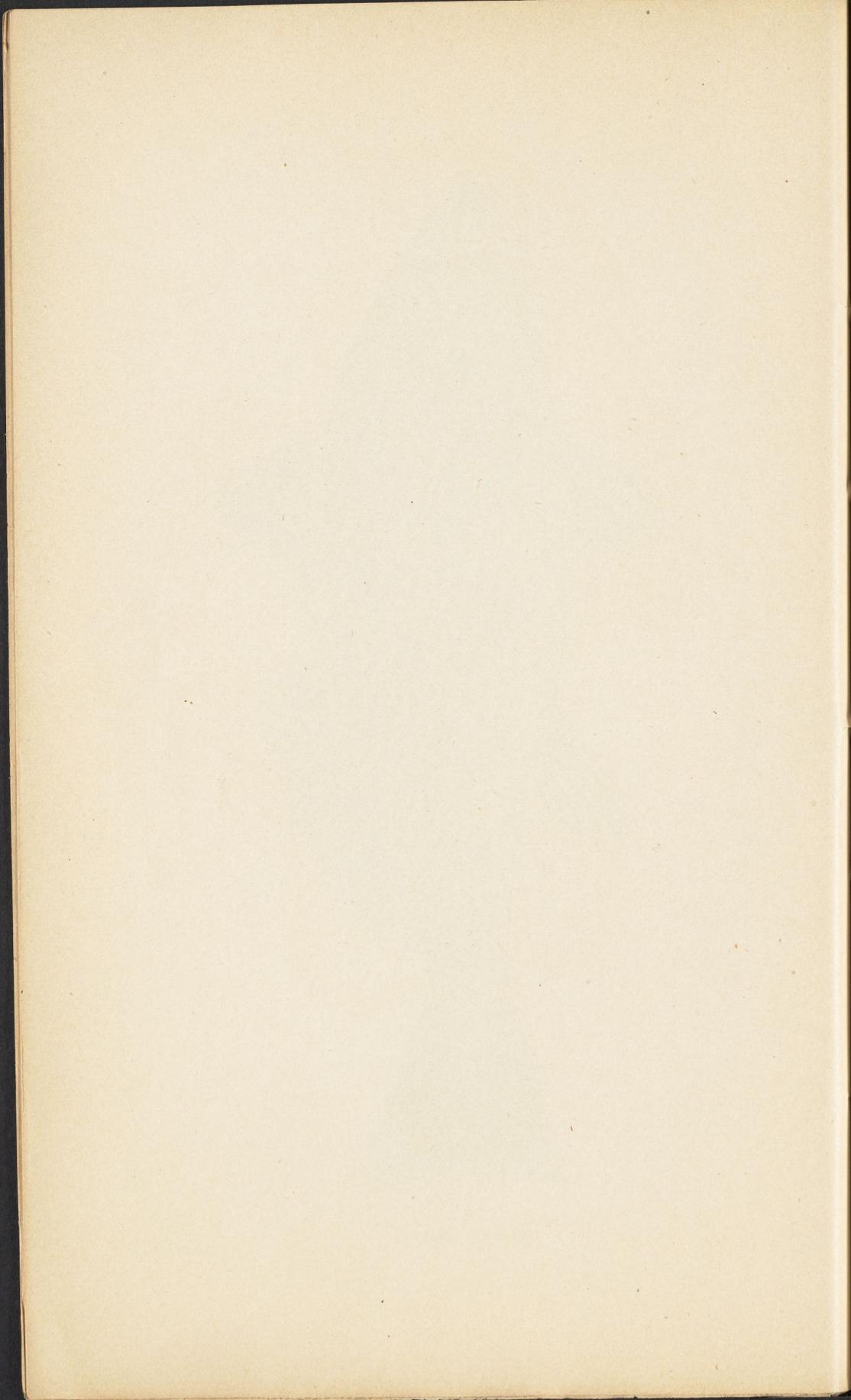
ANNA L. BROWN DEL.

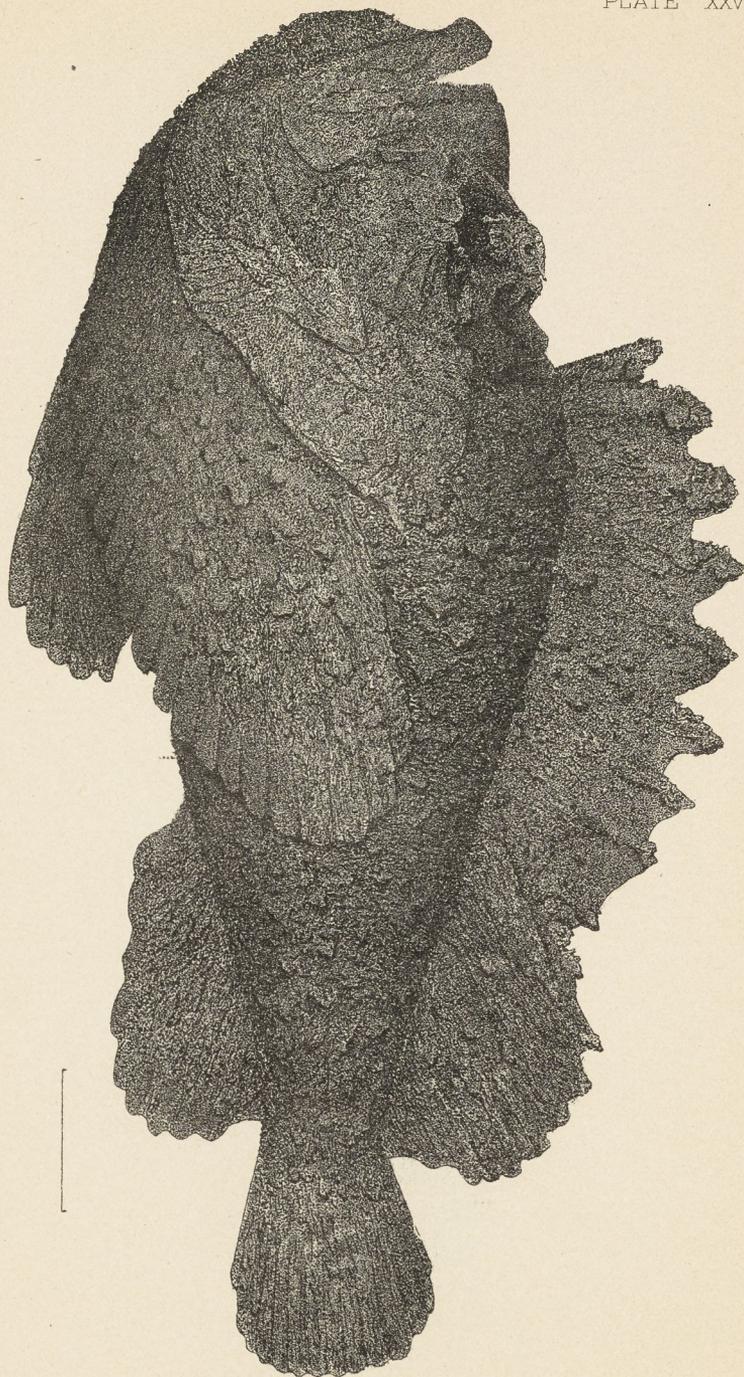
LITH. BRITTON & REY. SC.





UMBRINA SINALOË

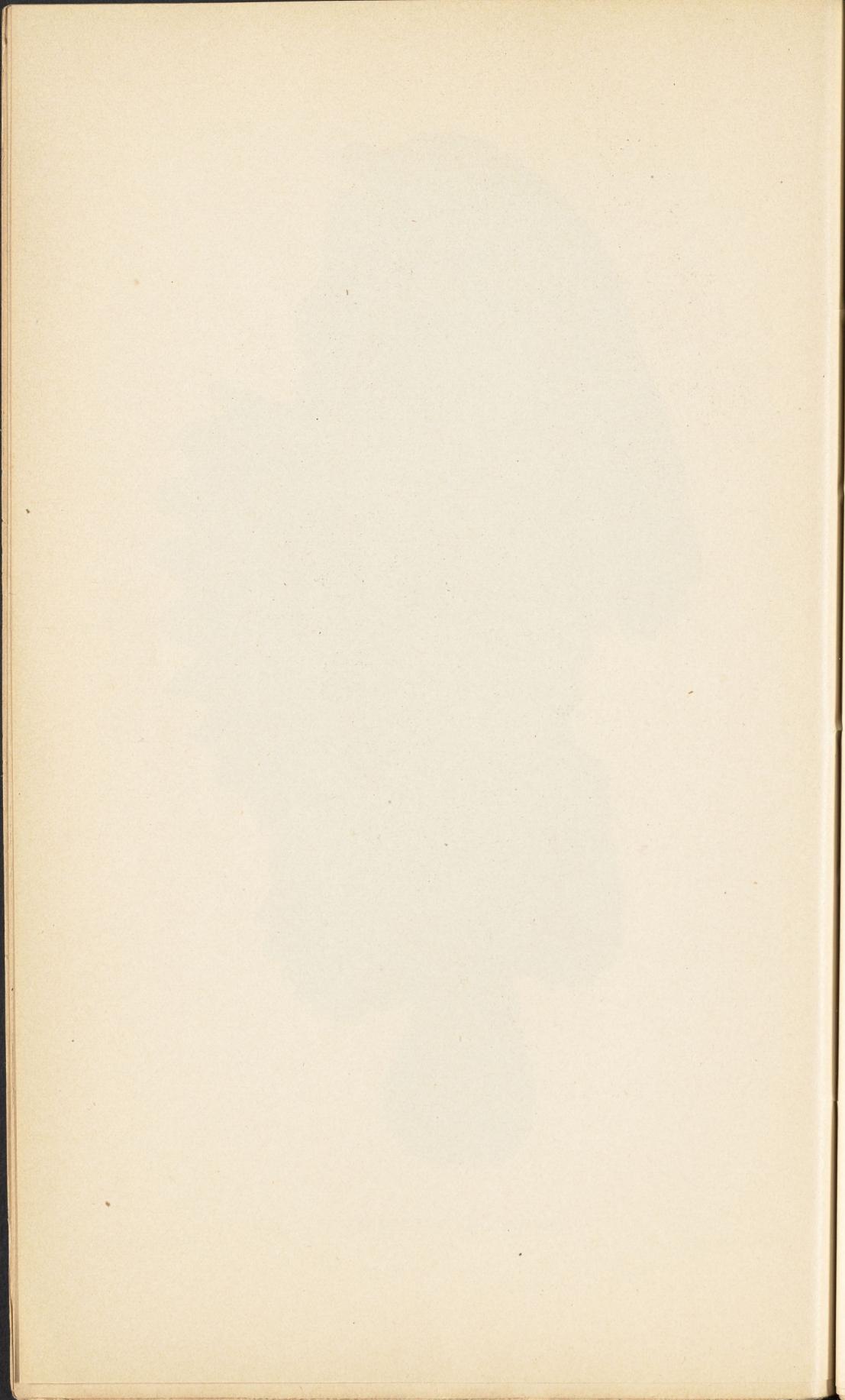


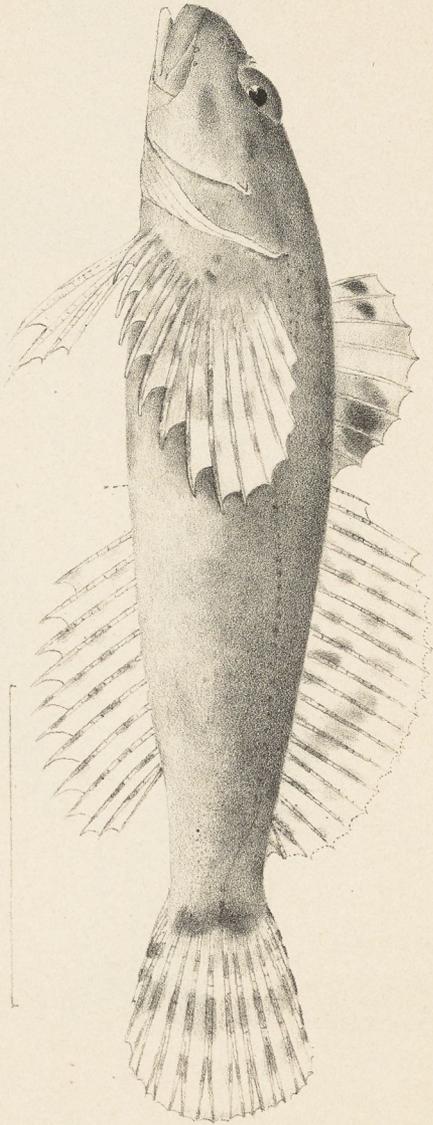


EMYDRICHTHYS VULCANUS

ANDR. L. BROWN, DEL.

LITH. DUTTON & REE, N.Y.





COTTUS ANNÆ

ANNA L. BROWN, DEL.

LITH. BRITTON & REY, SR.

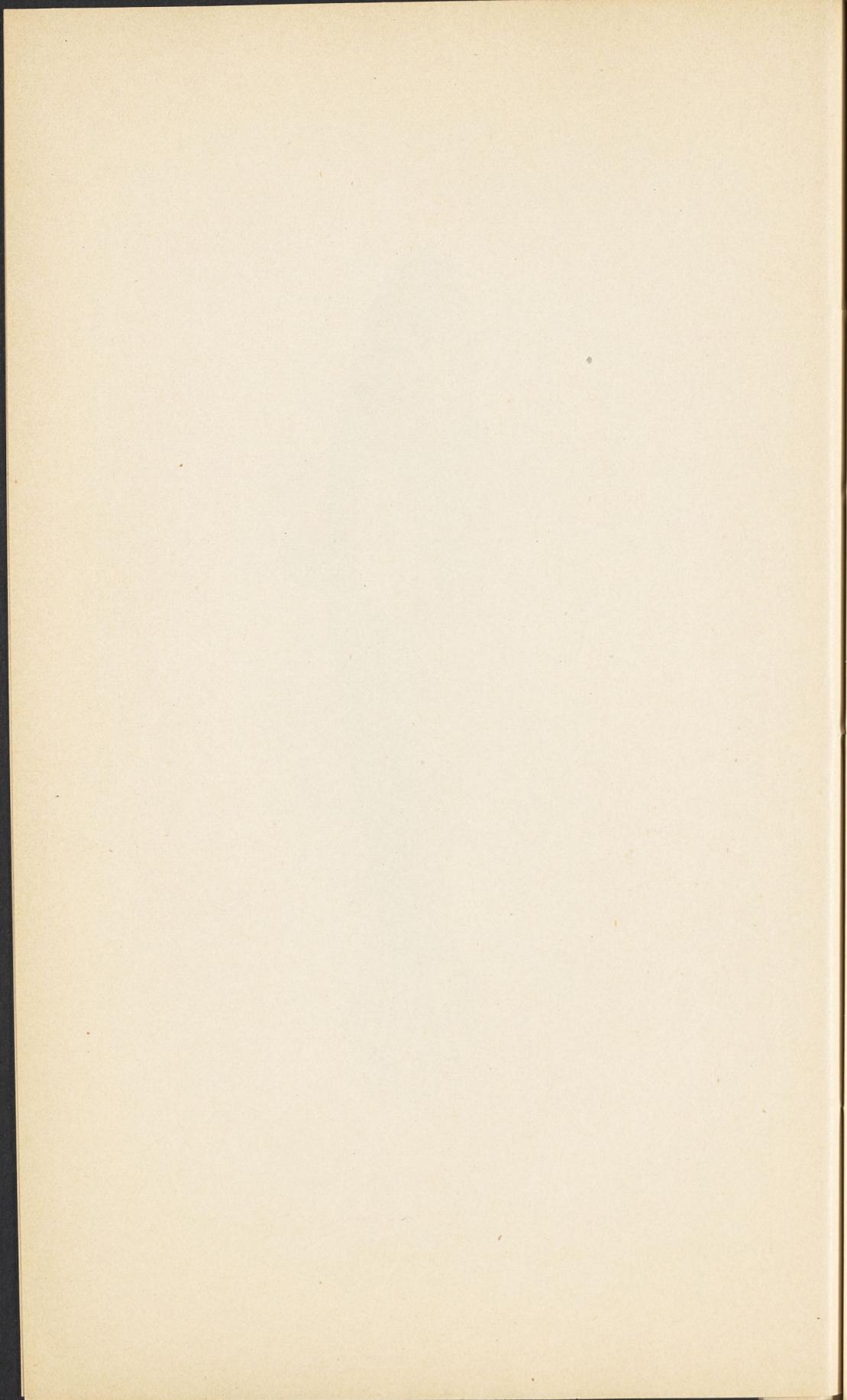
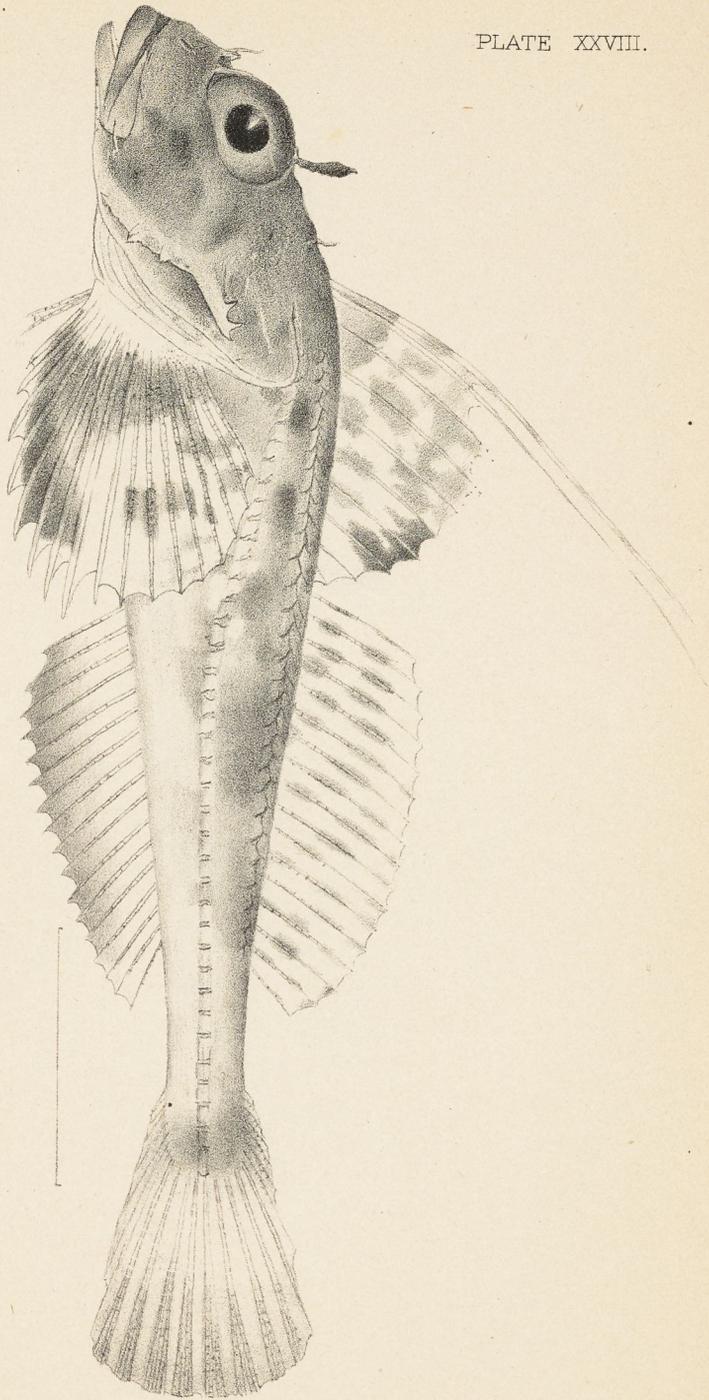


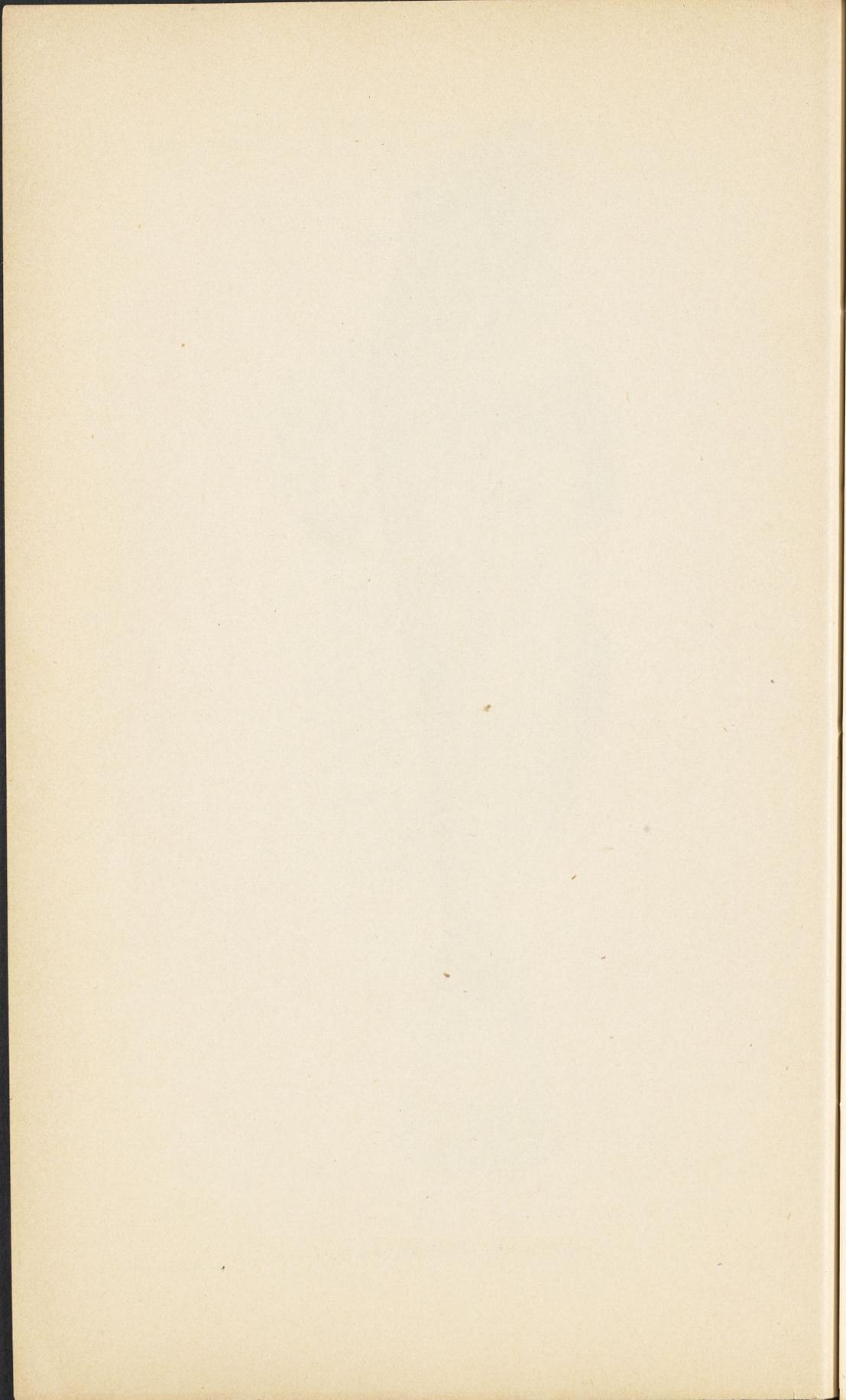
PLATE XXVIII.



TARANDICHTHYS FILAMENTOSUS

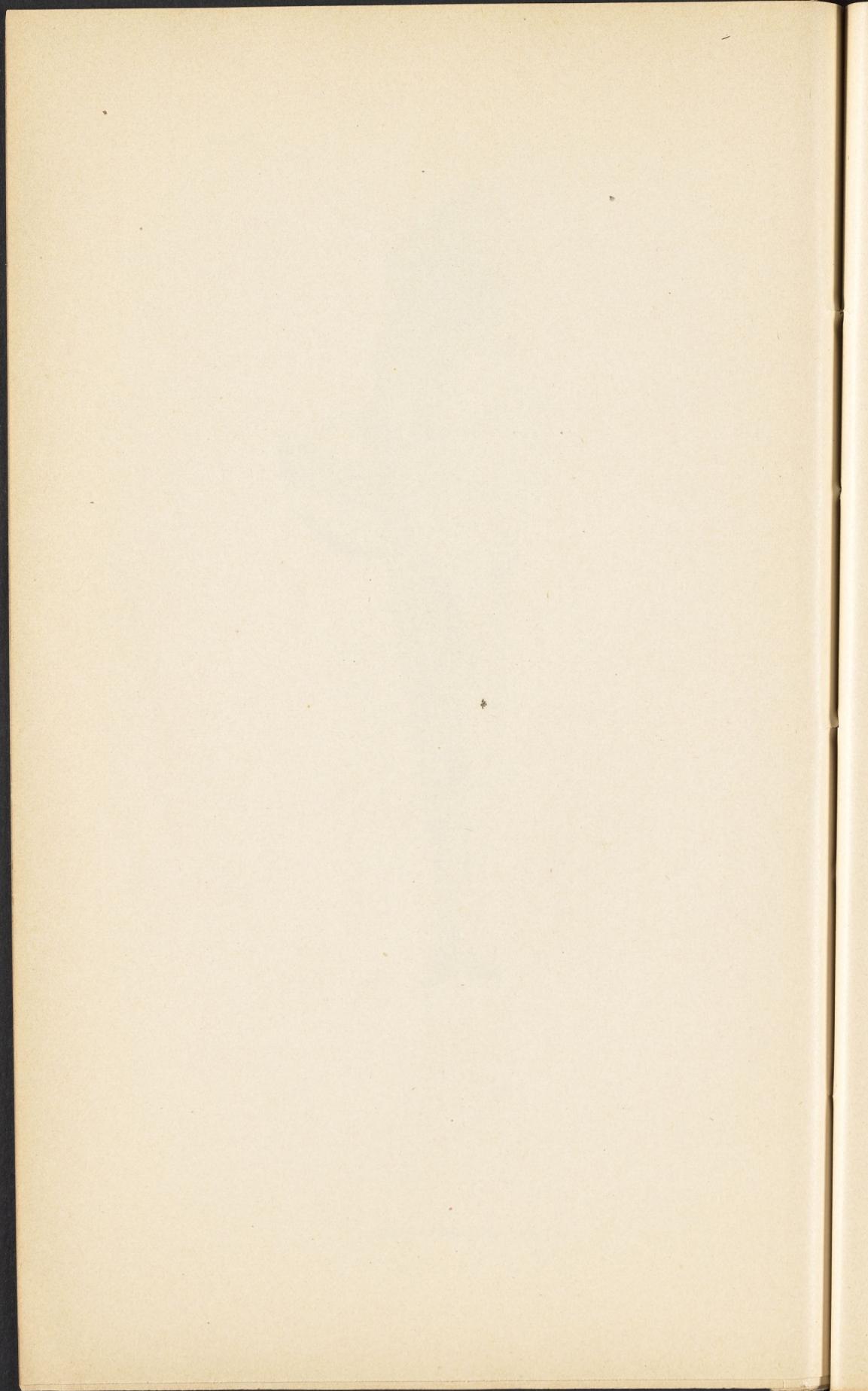
ANNA L. ERFORD, DEL.

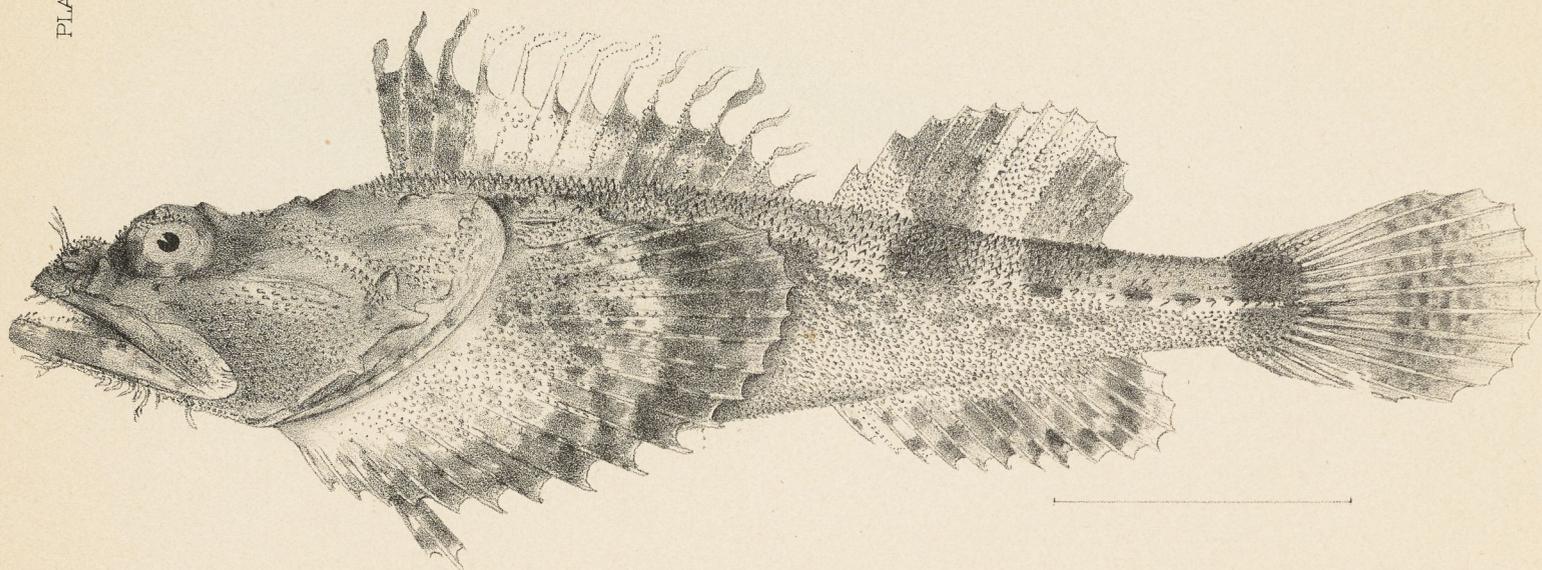
LITH. BRITTON & REY, SF.





ICELINUS QUADRISERIATUS

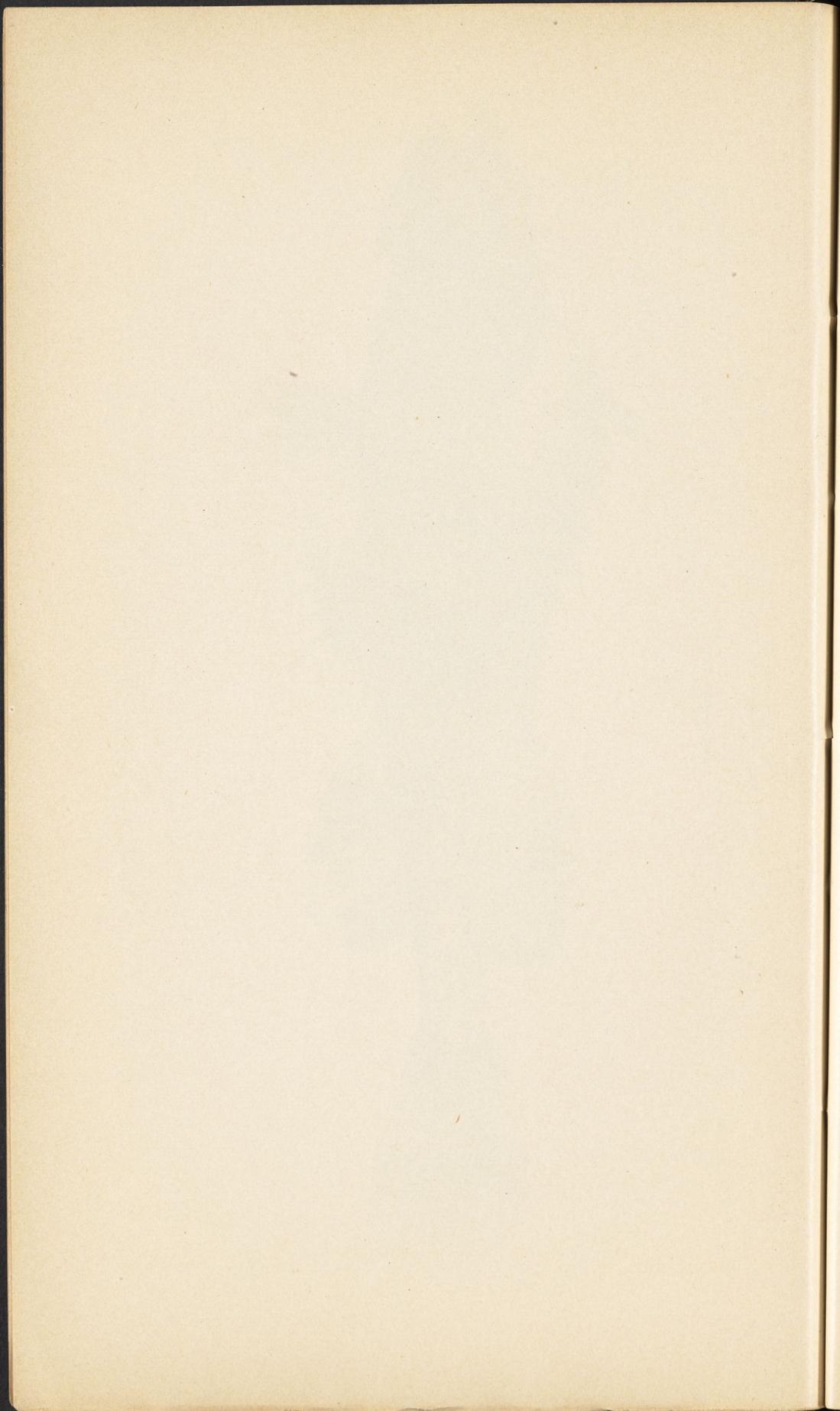


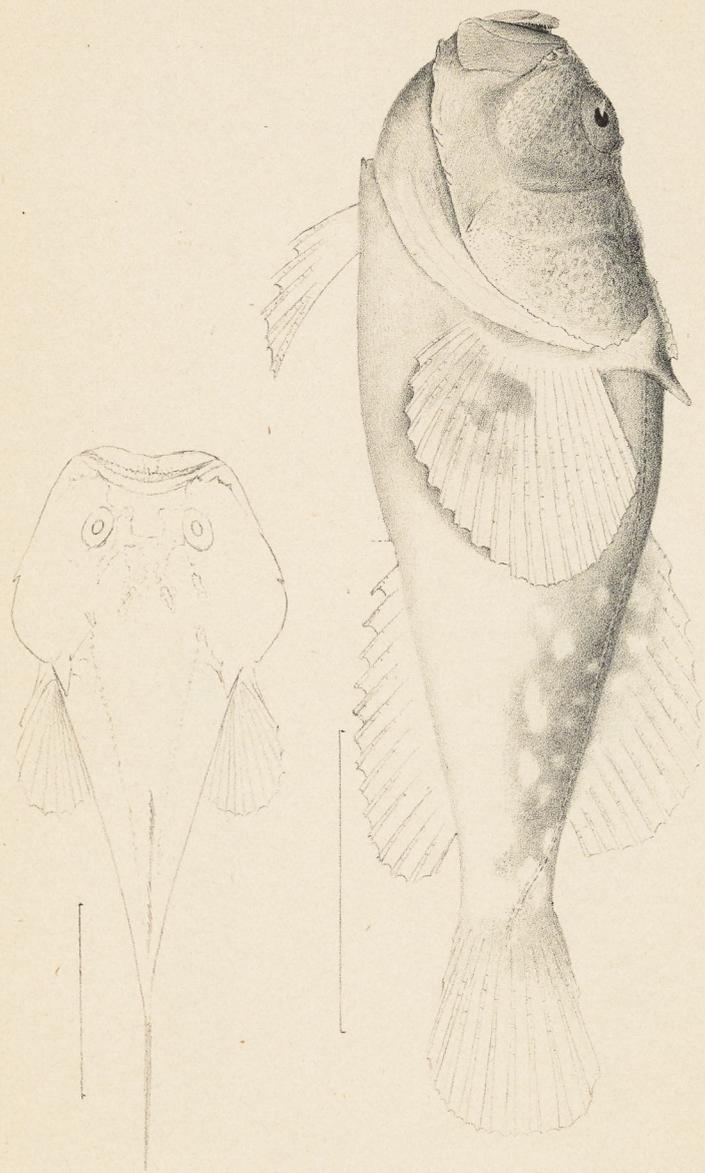


ANNA L. BROWN, DEL.

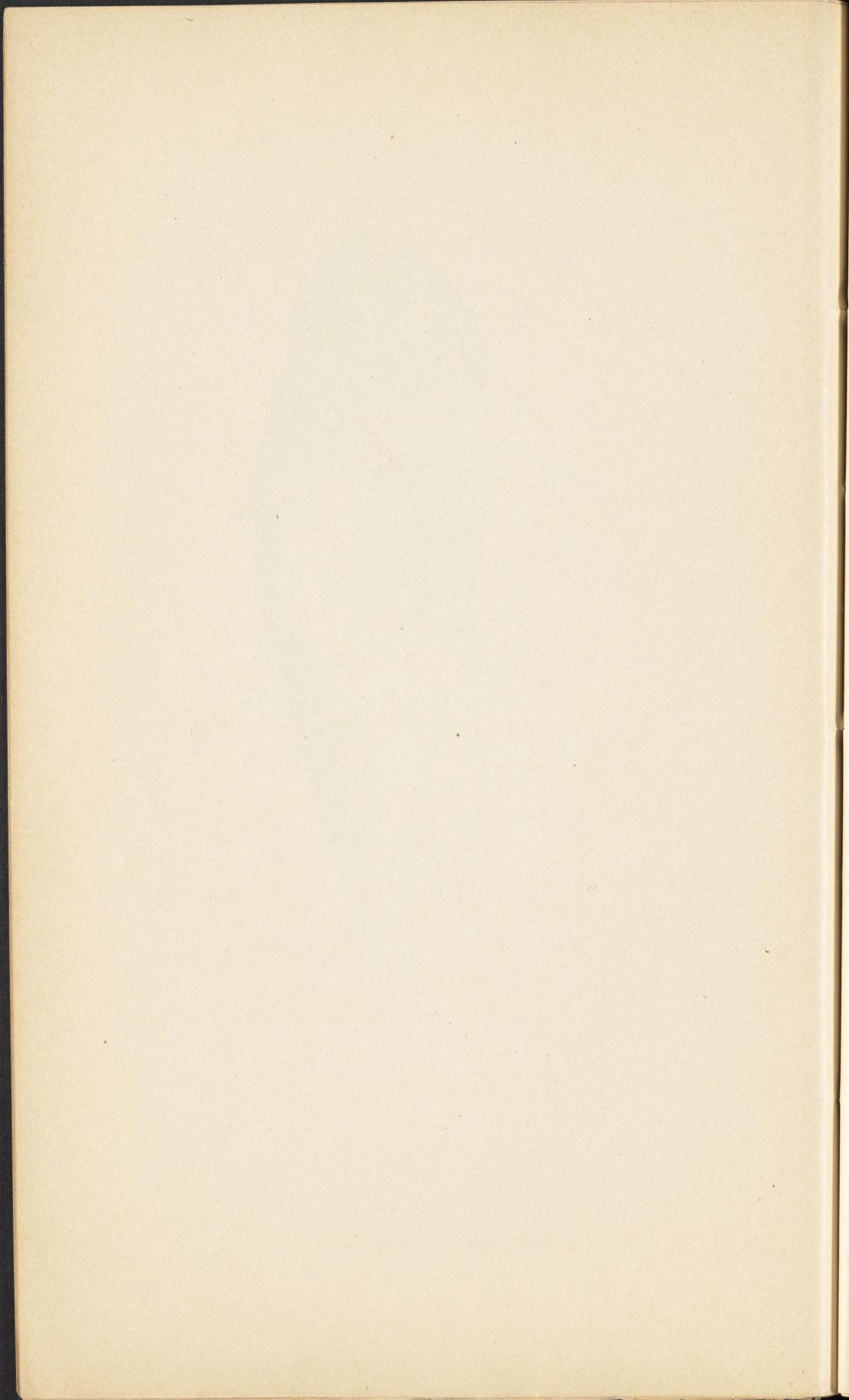
ULCA MARMORATA

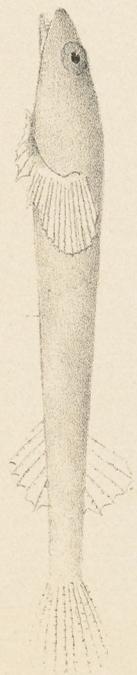
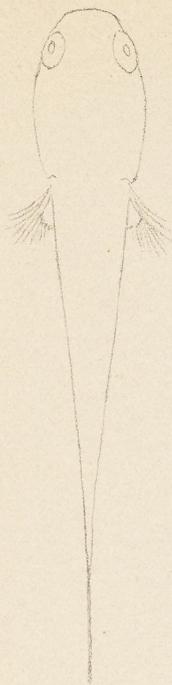
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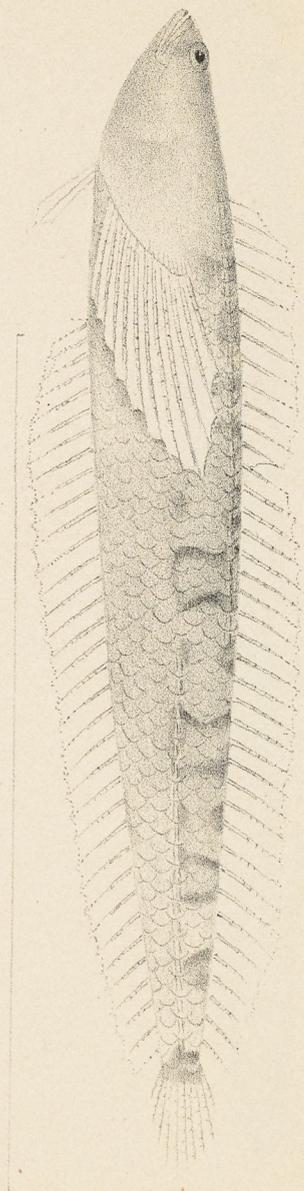
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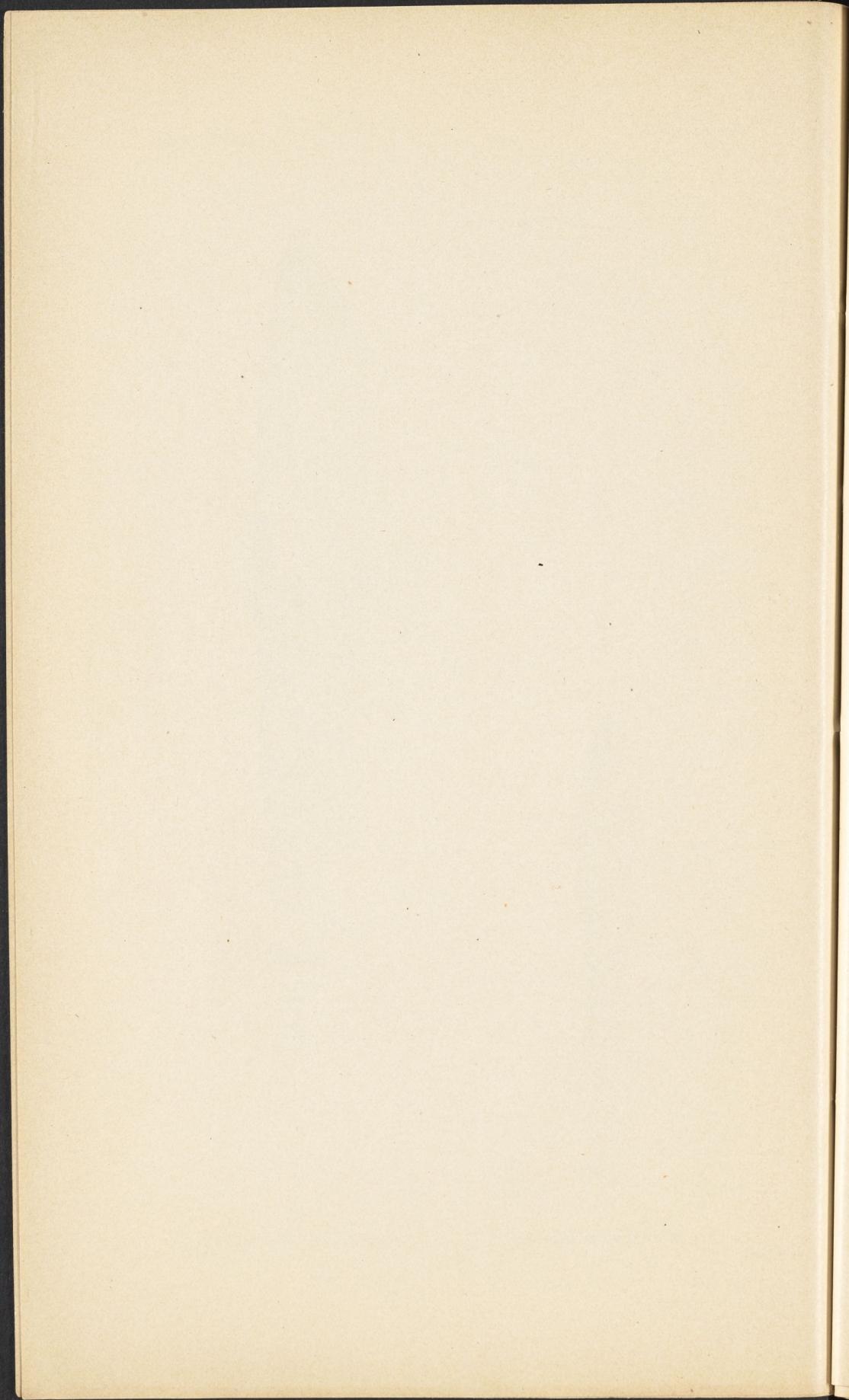
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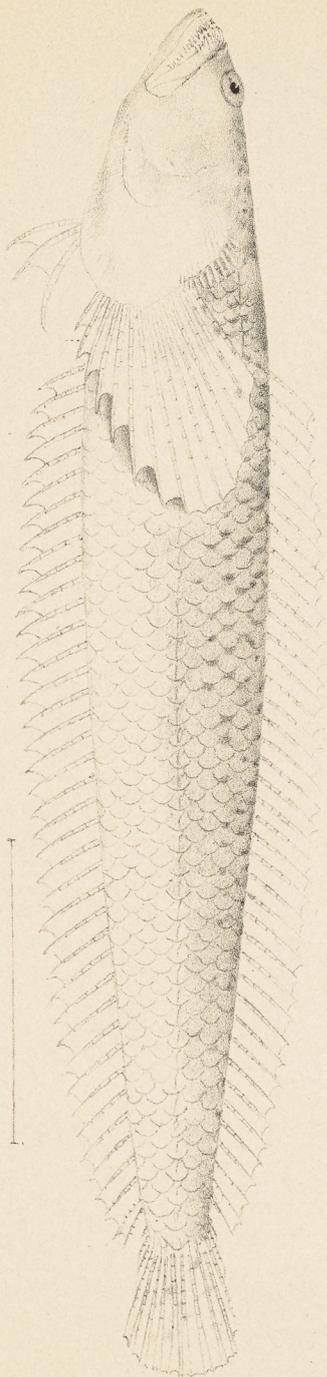
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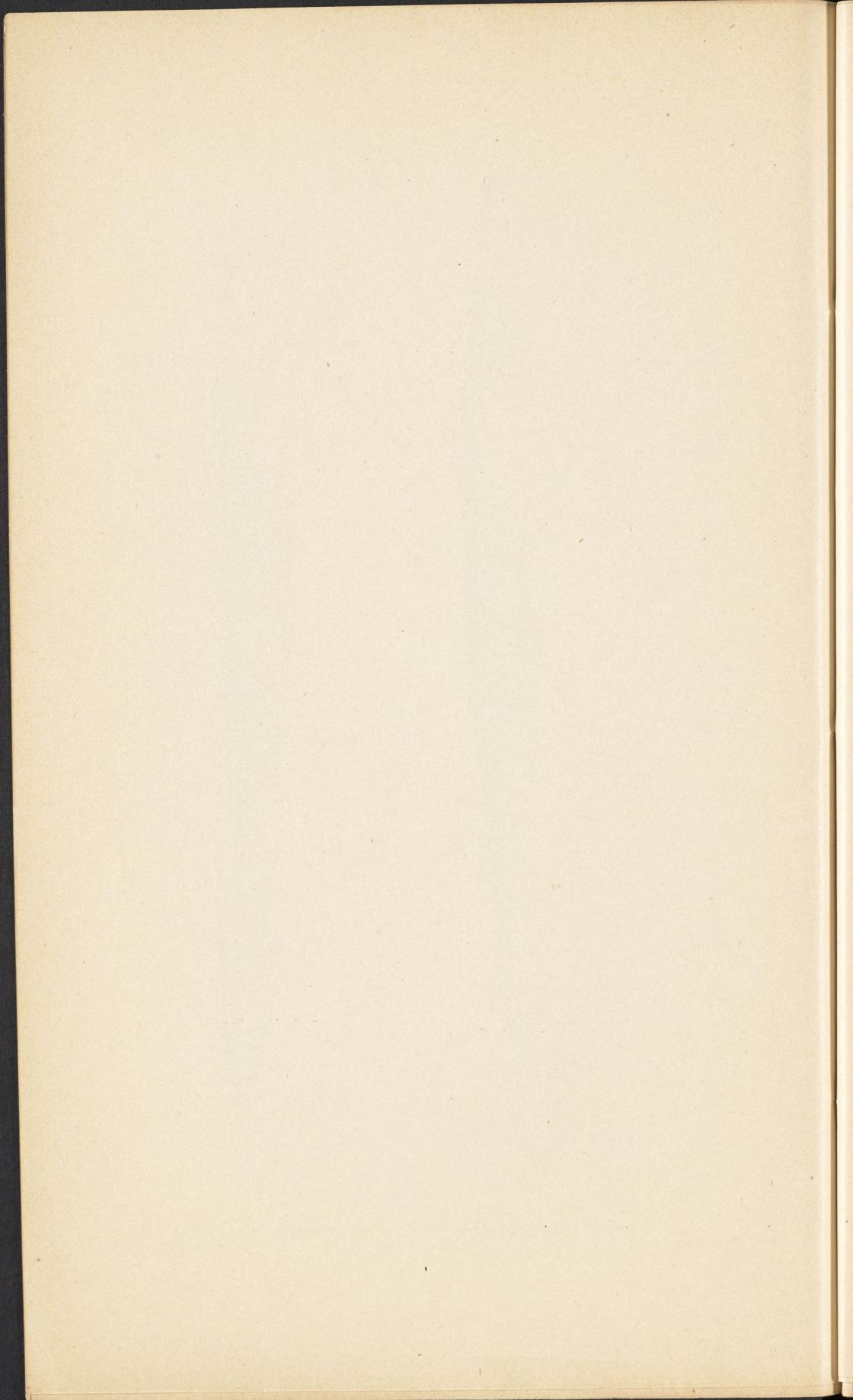
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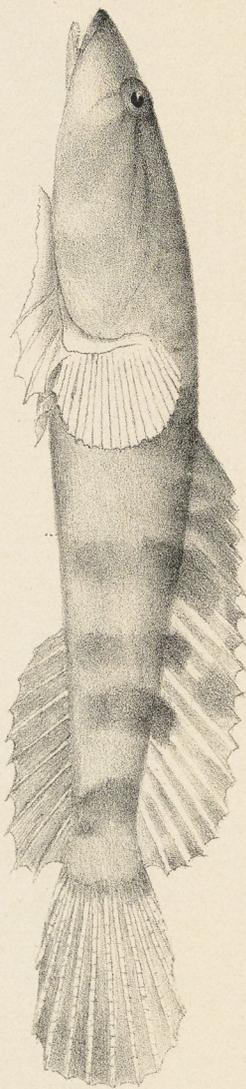
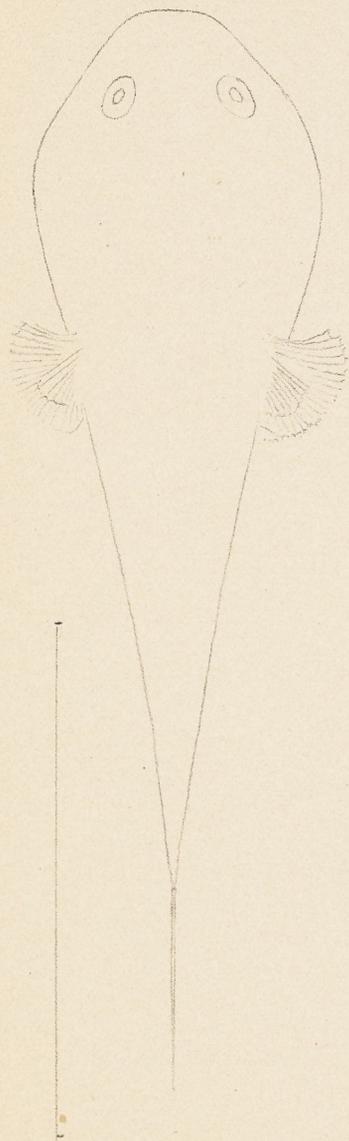
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LYCODAPUS FIERASFER

*Lith. Britton & Ross, S.F.*

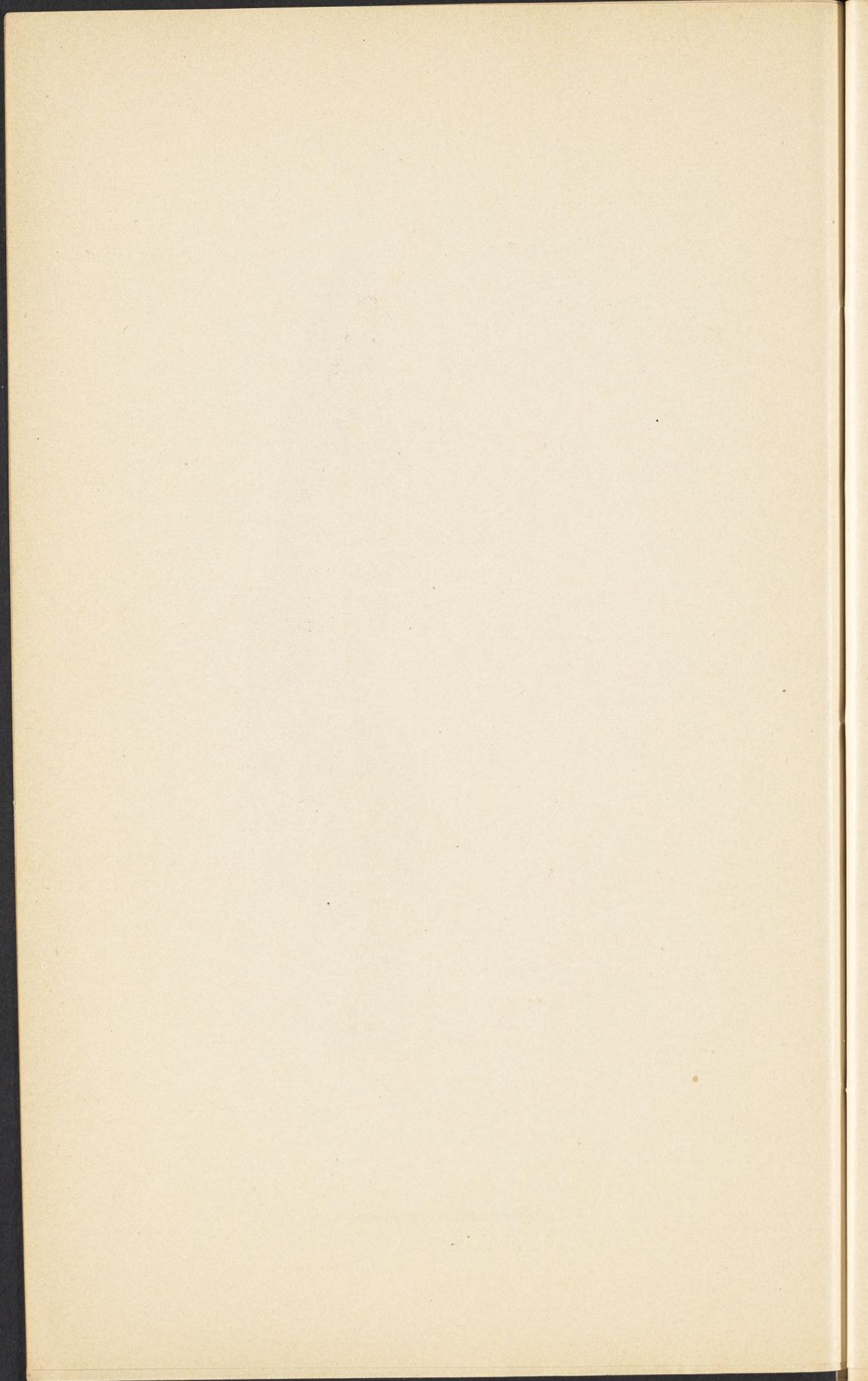




BRYSETÆRES PINNIGER

*Anna L. Brown, Del.*

*Lith. Britton & Rey, Jr.*

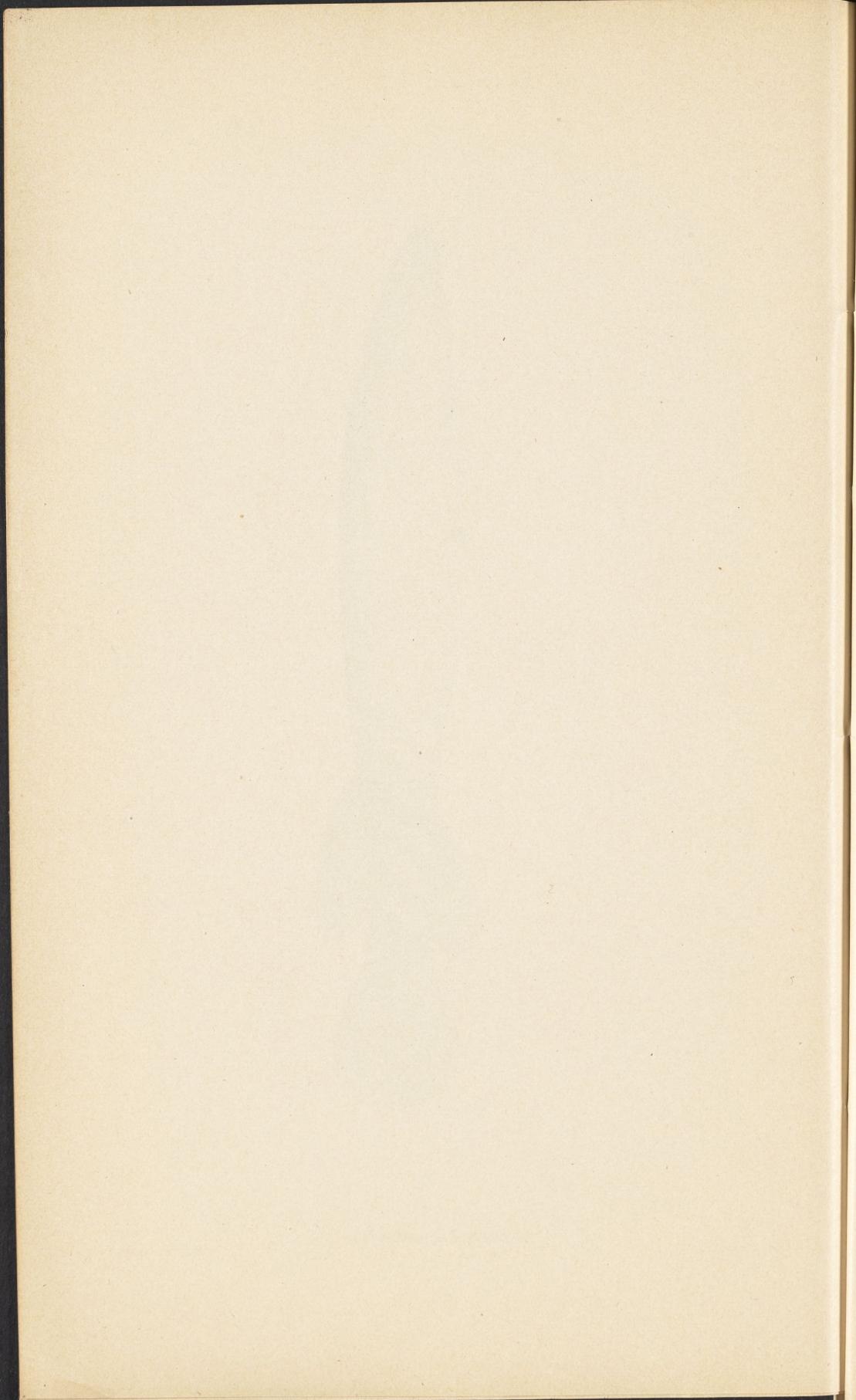


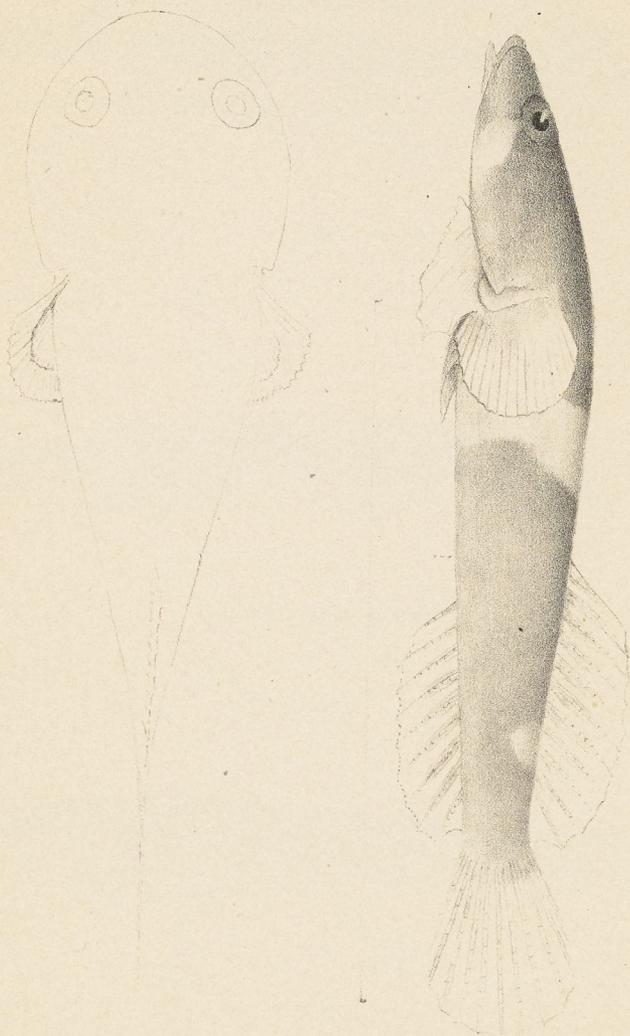


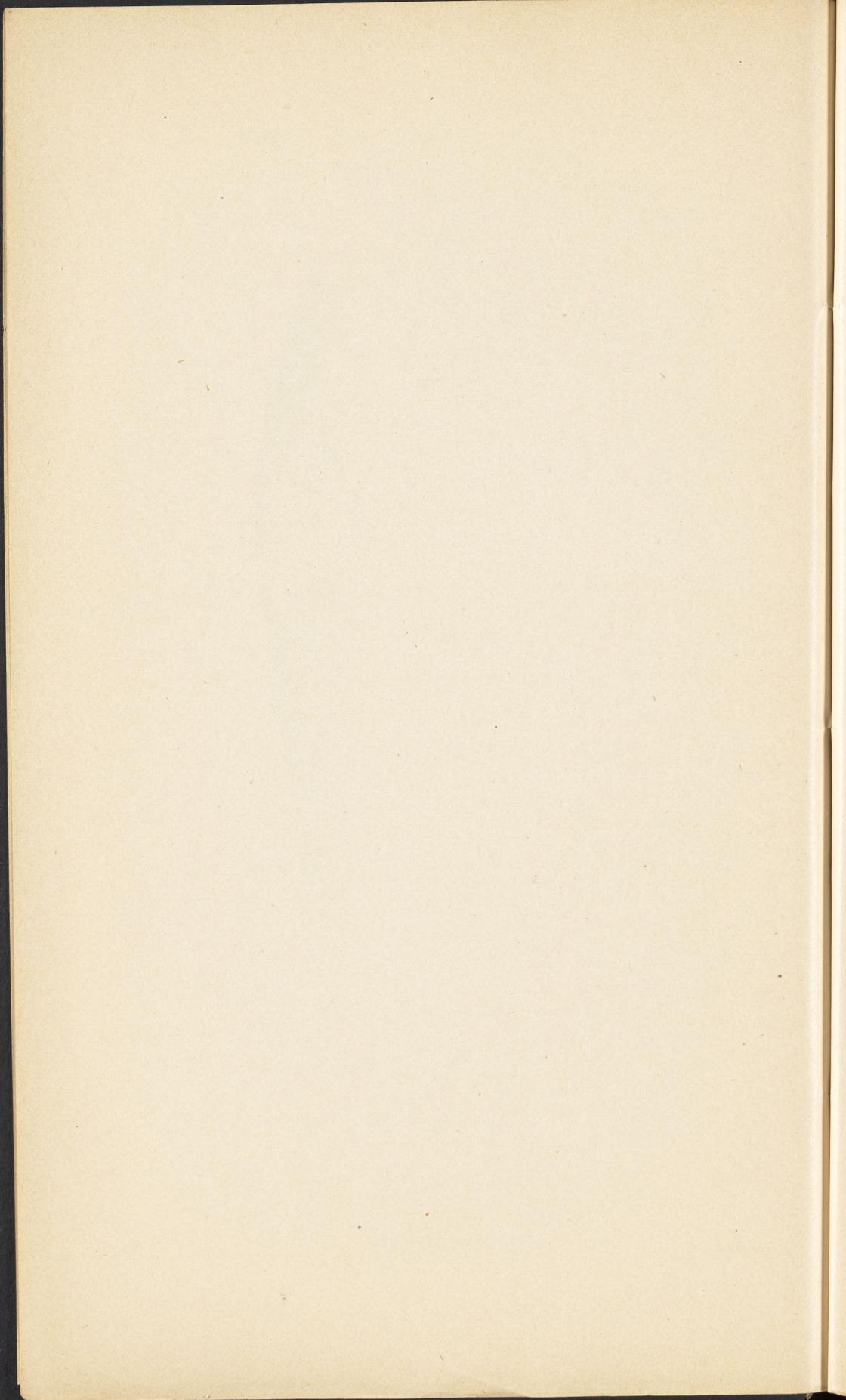
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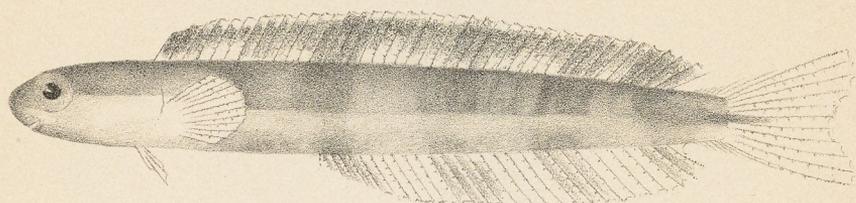
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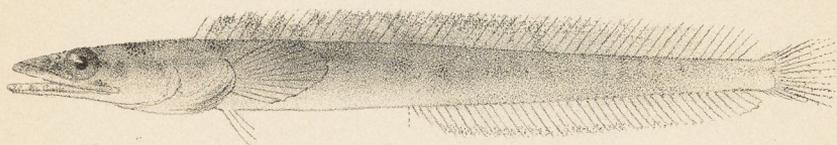




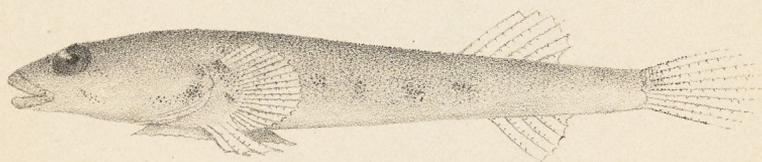




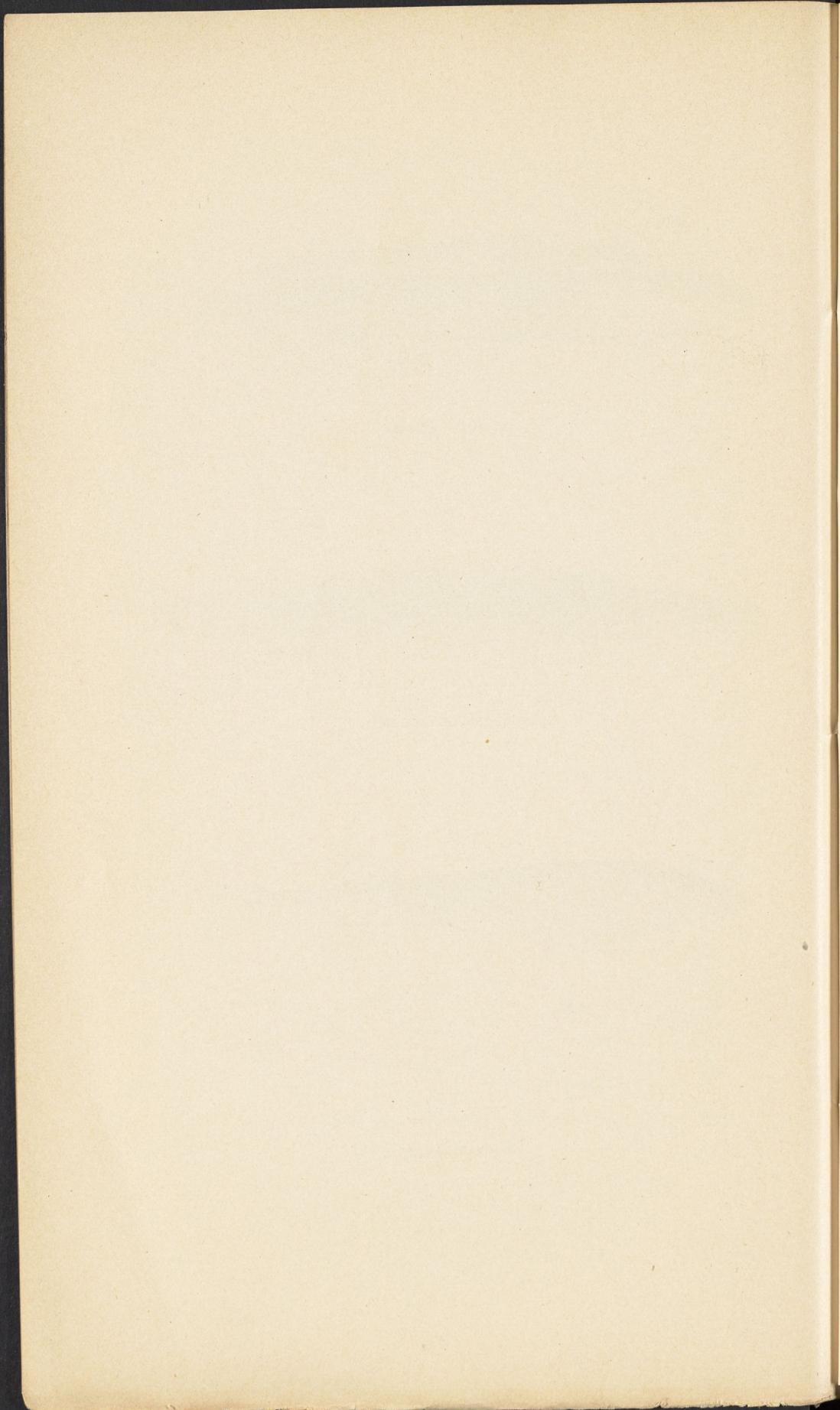
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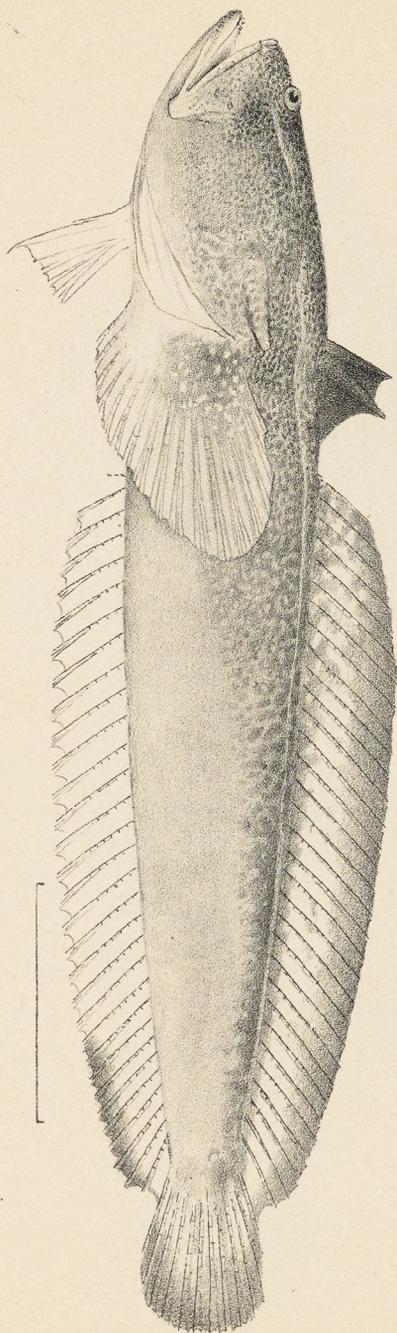


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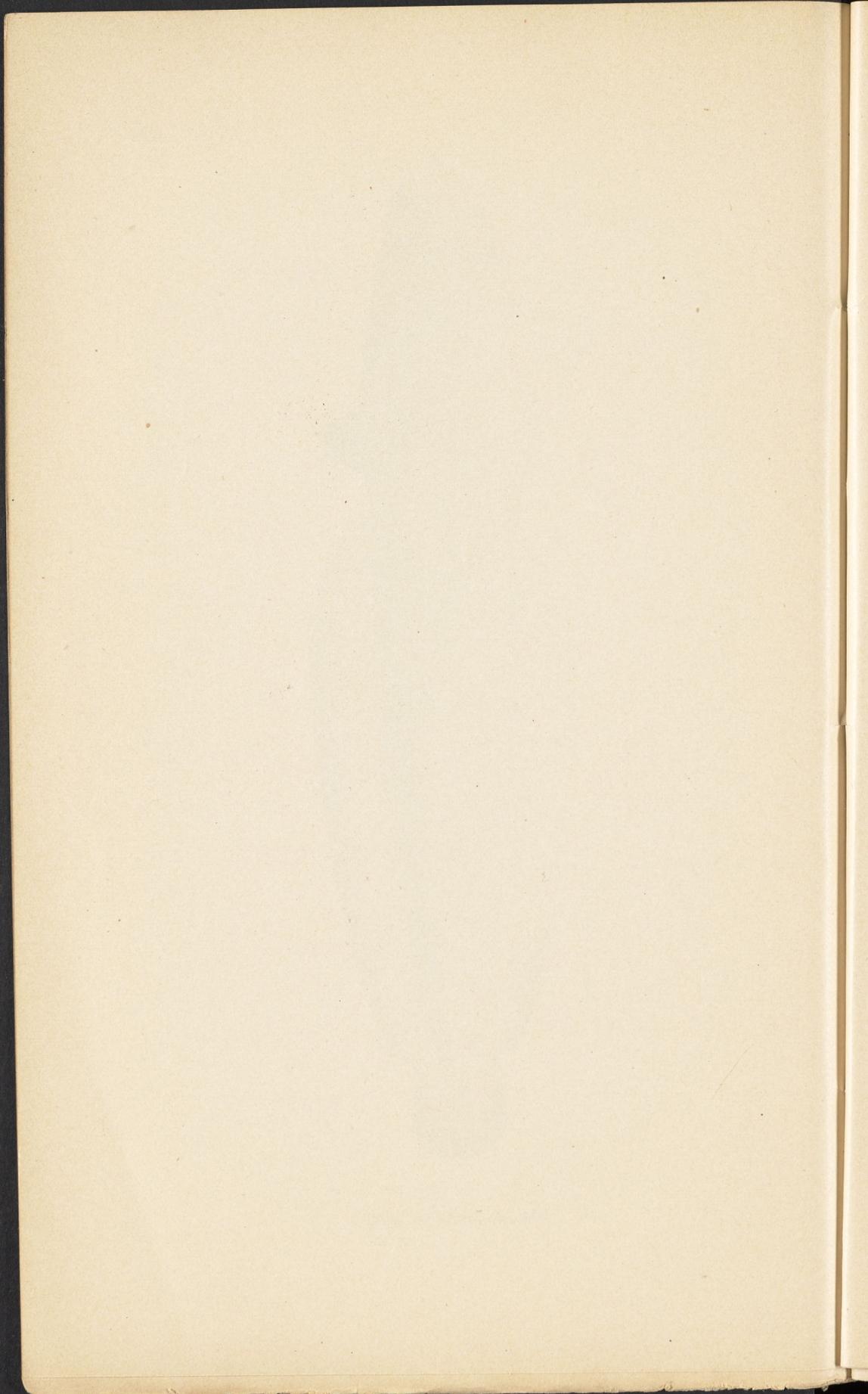


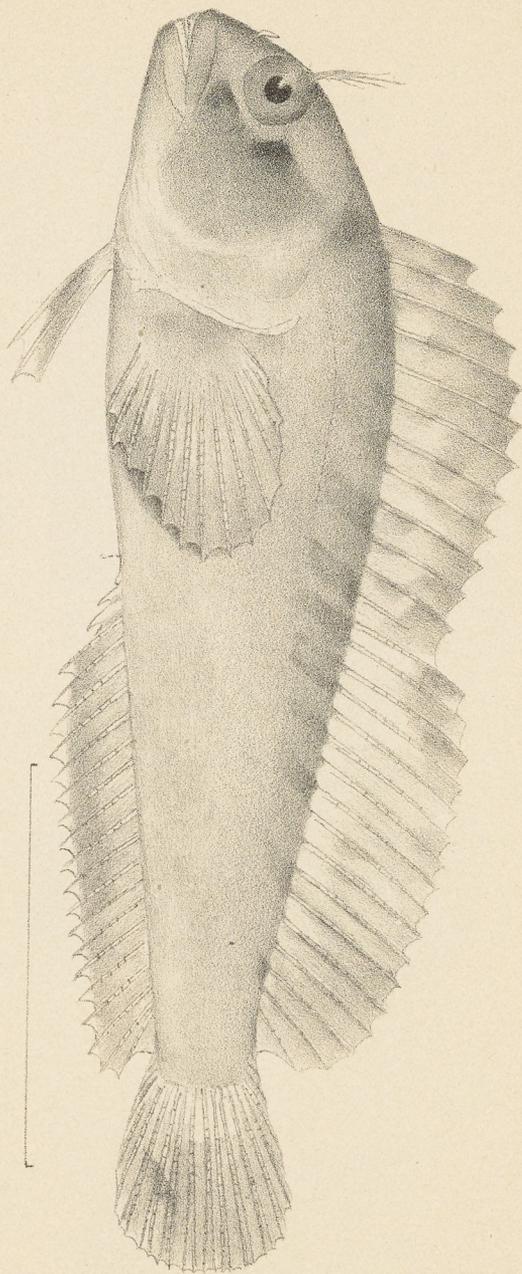


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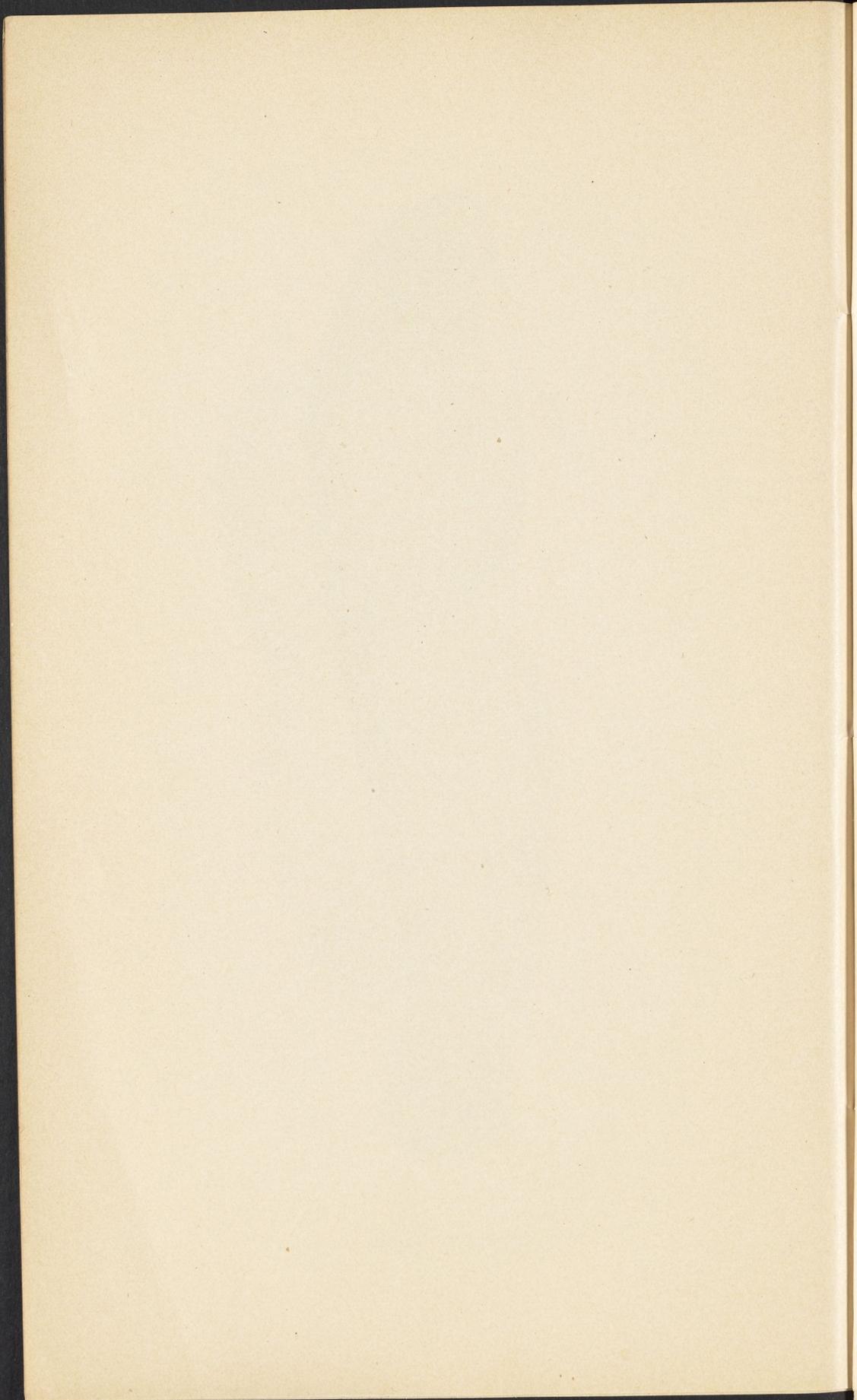
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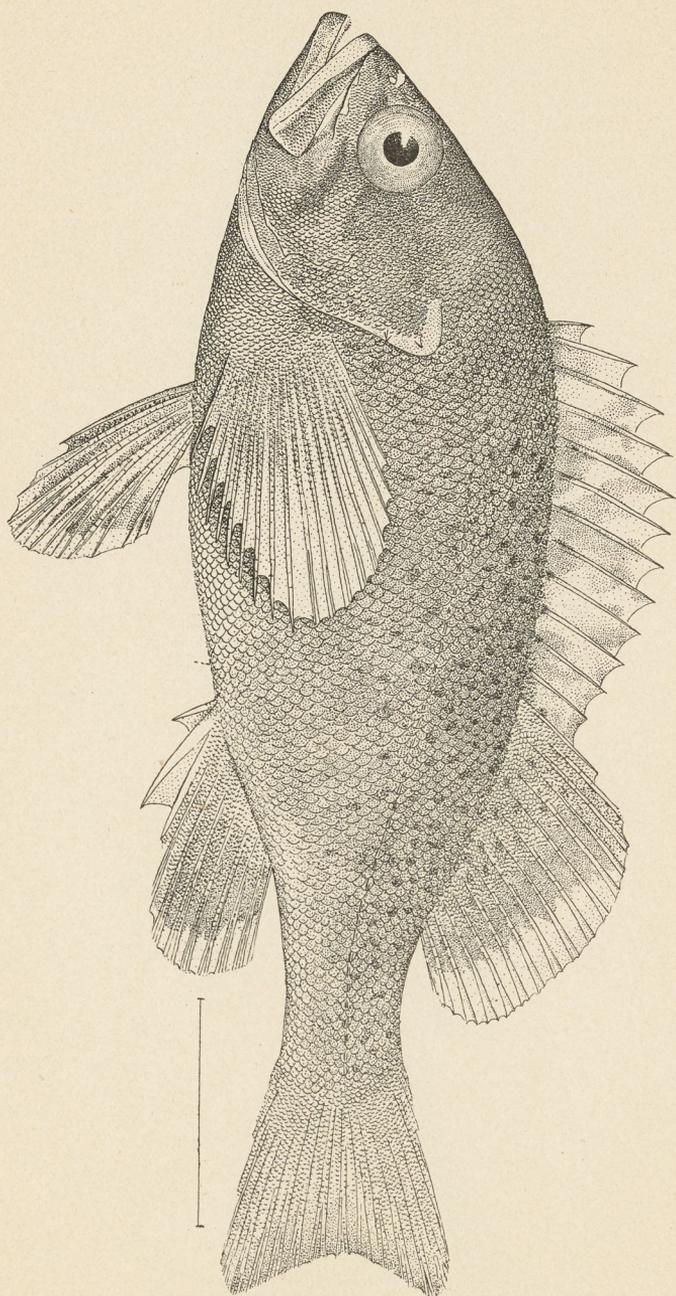
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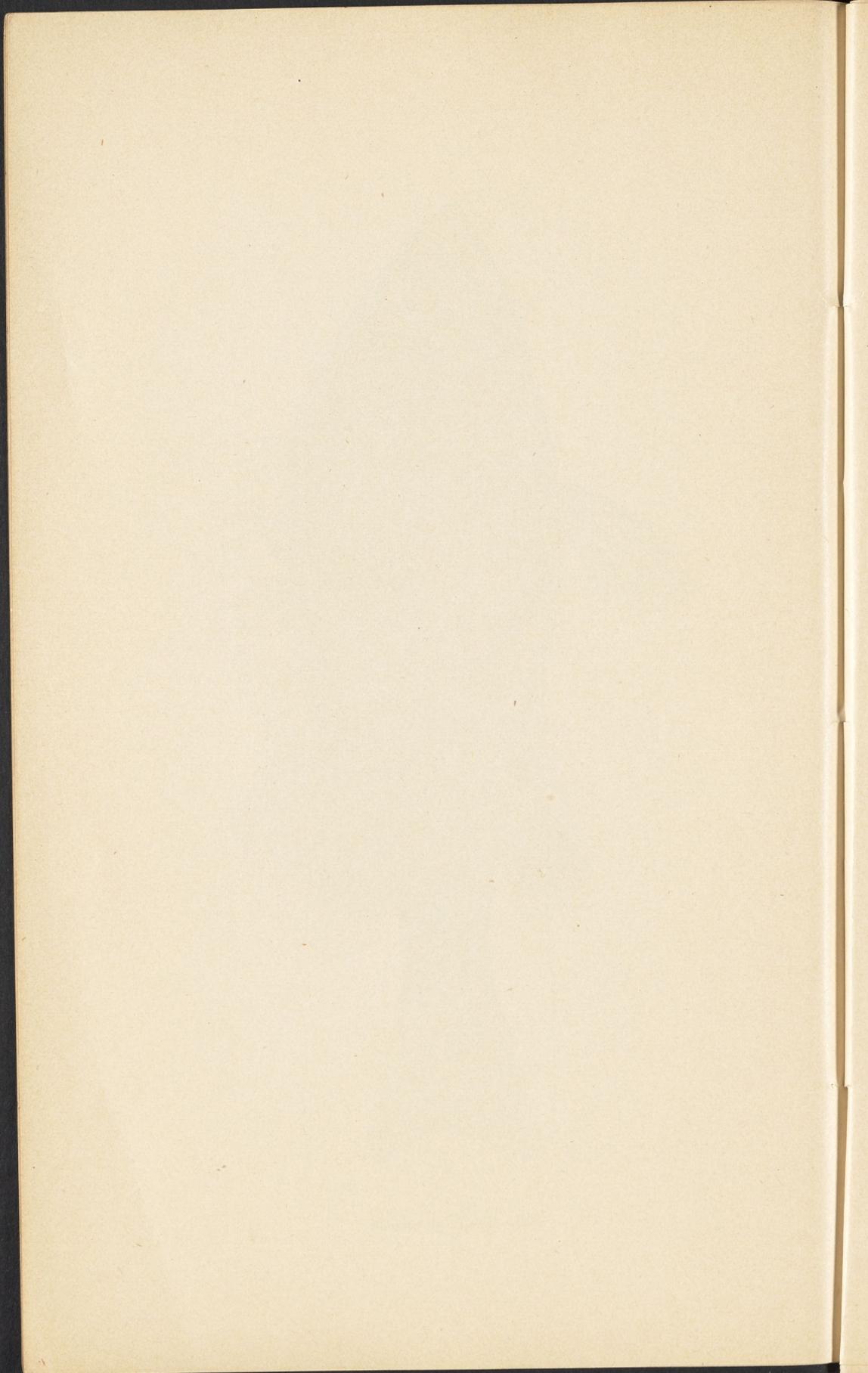


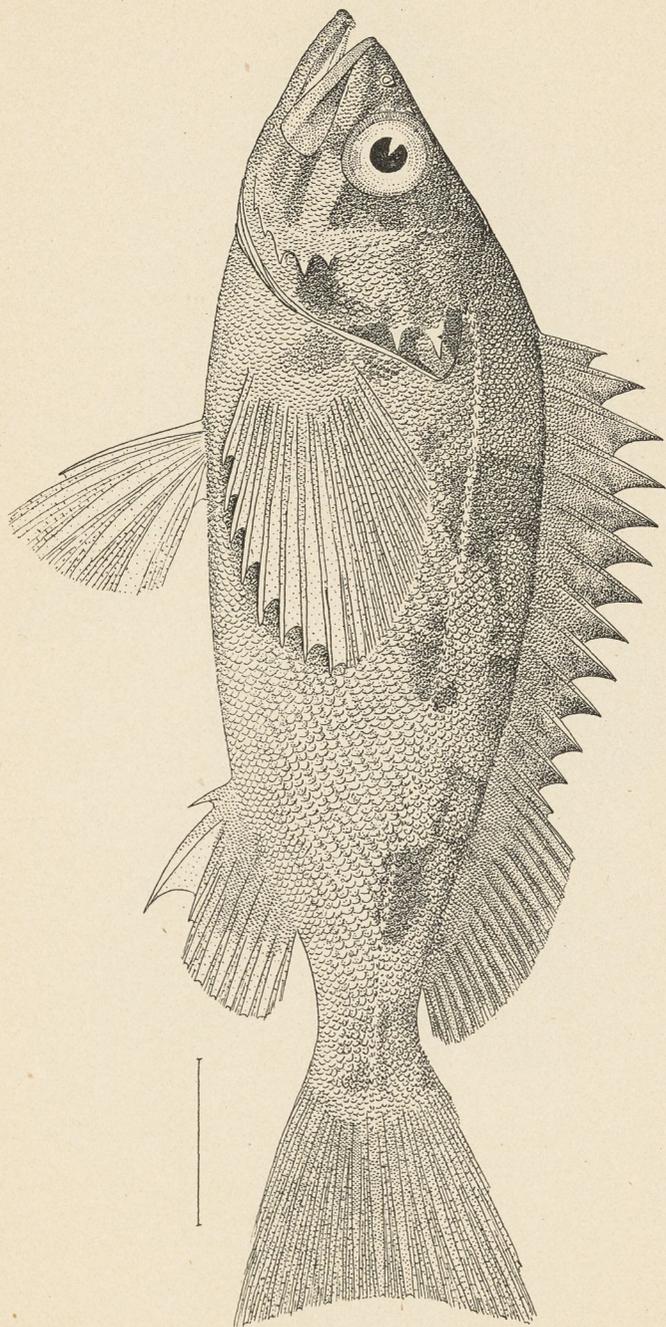
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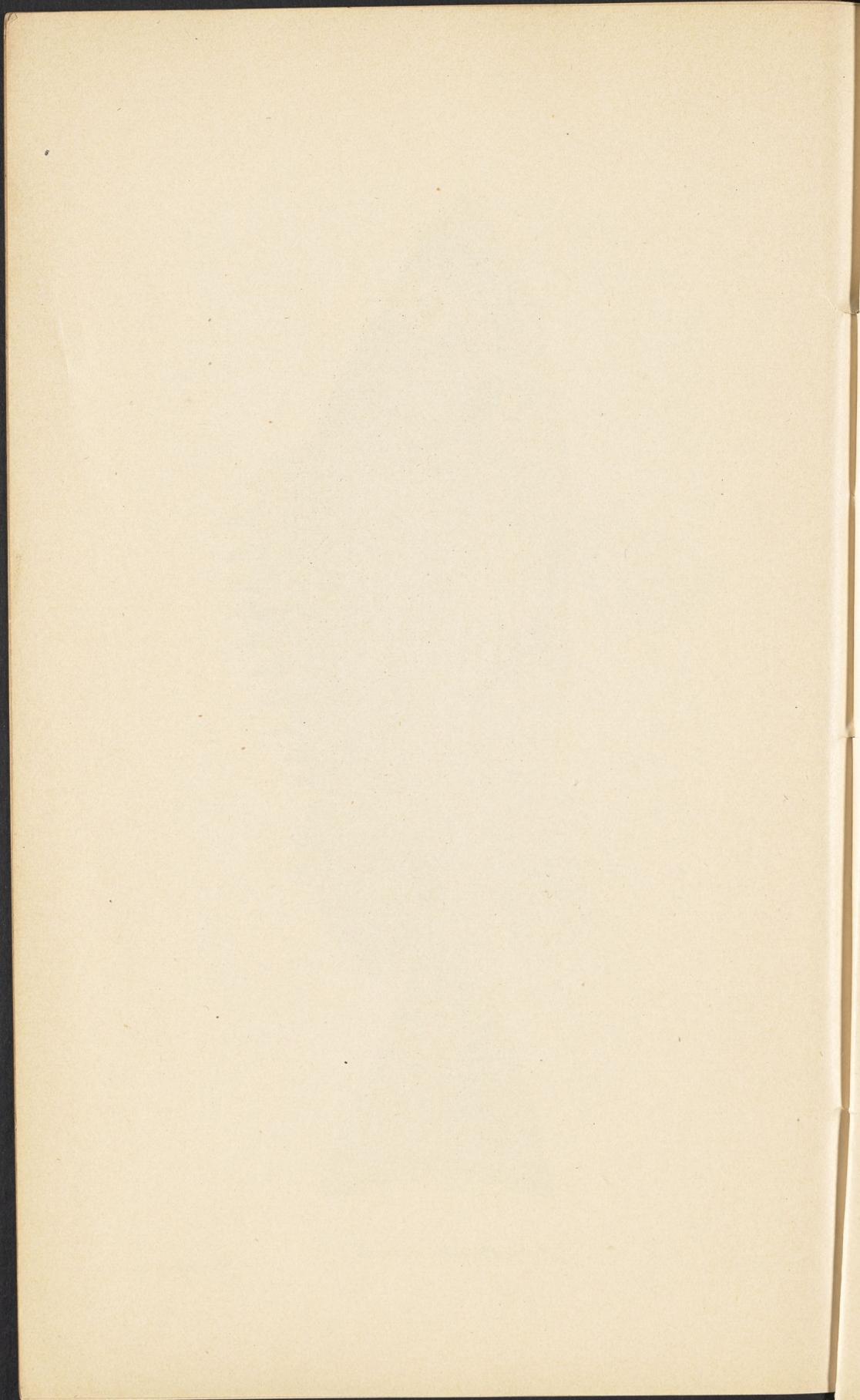


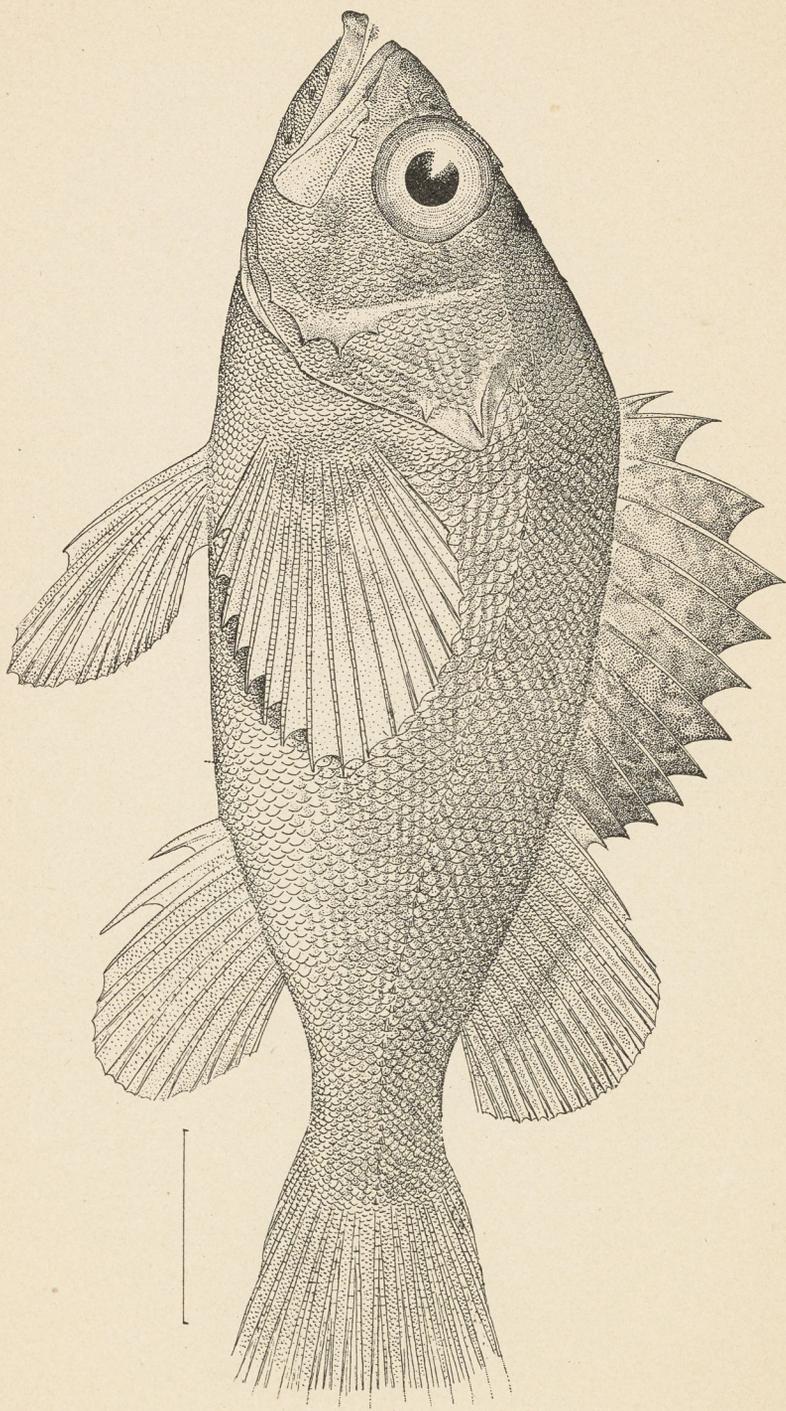
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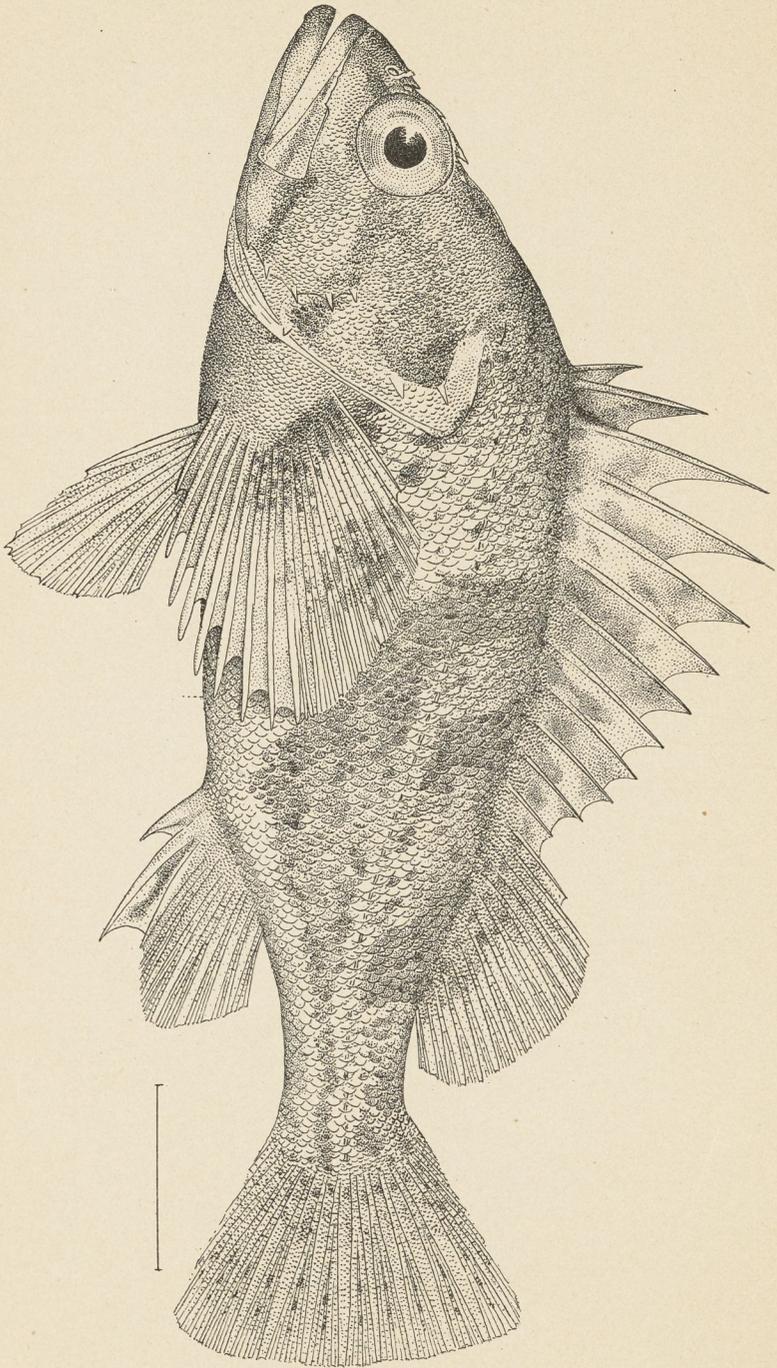
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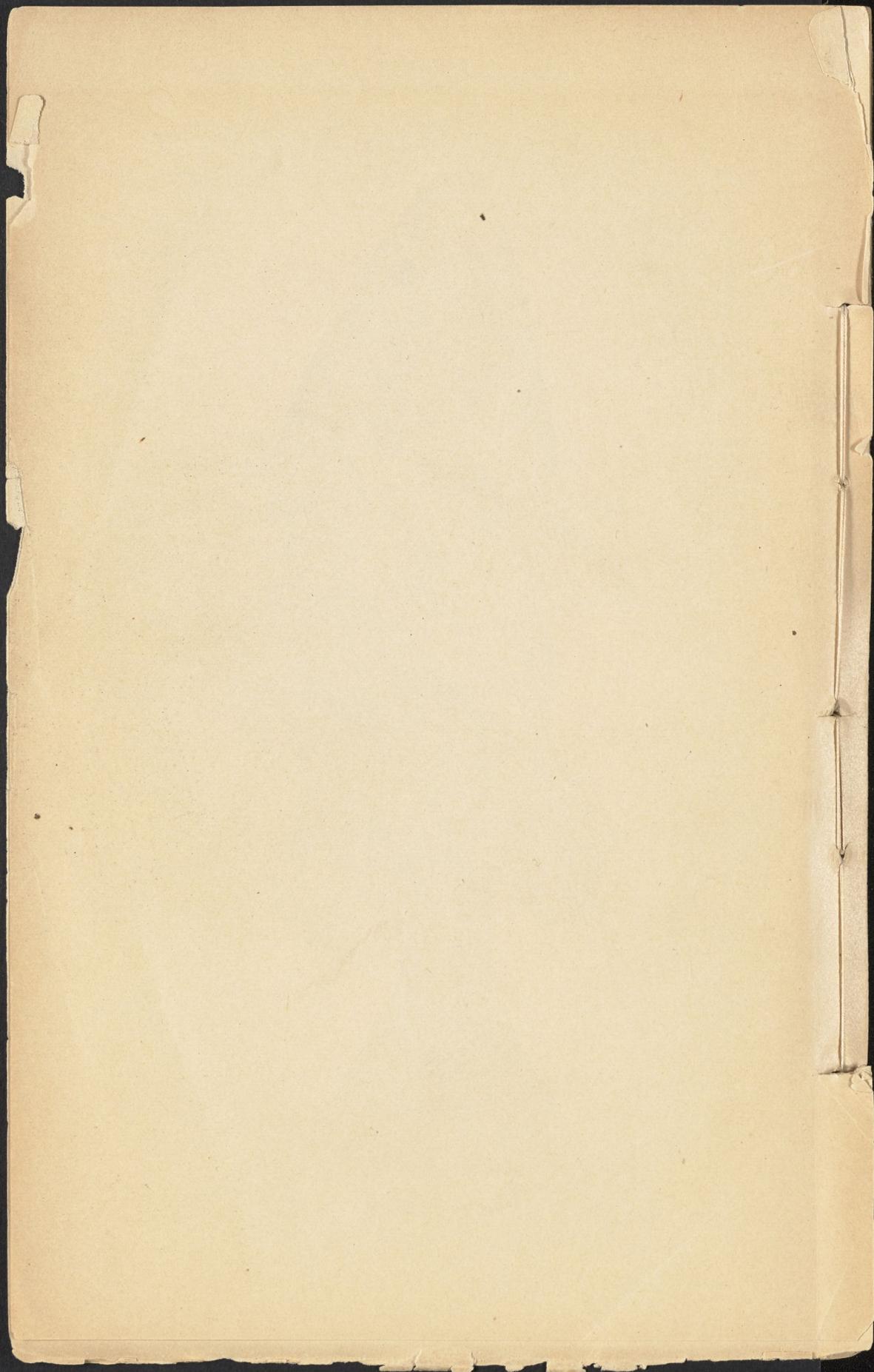


SEBASTODES EIGENMANNI





SEBASTODES GILBERTI



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Fishery Leaflet 355

Washington 25, D. C.

November 1949

THE TROUTS OF NORTH AMERICA

General Remarks on Classification

By Samuel F. Hildebrand \*  
Fish and Wildlife Service

The trouts of North America are exceedingly difficult to classify - so difficult that scarcely two ichthyologists agree. A form that one authority recognizes as a distinct species may be regarded by another as only a subspecies, variety or race. Prof. John O. Snyder, who has studied the trouts of western North America for many years, recently (1940, p. 98) said of them, "In their entirety they seem to form a huge mosaic, the elements of which, as diverse as the golden trout of the High Sierra, the coast rainbow and the royal silver trout of Lake Tahoe, are difficult to separate. The picture includes not only the colors of the entire spectrum, but numerous irregularities of form, anatomical structure and habits as well. The trout present a veritable medley of geographic races or forms that make logical treatment very difficult. Attempts at systematic investigation have been made and some generally accepted species have been recognized. These attempts have been sporadic in all cases; they have been founded upon insufficient material, and they have not contributed greatly to a reasonable interpretation of the situation as a whole. The problem may now be impossible of satisfactory treatment because of depletion or near extermination of certain forms of restricted distribution and of the activities of artificial propagation in the distribution of various trouts."

The so-called steelhead trout offers an illustration of the difficulty that ichthyologists have met in classifying trouts. This form was long regarded as related to, but distinct from the rainbow trout. However, Snyder (1940, p. 101) stated "Some observers hold the belief that the steelhead is a distinct species of trout somewhat intermediate between the cutthroat and the rainbow. Such is not the case, and this statement is supported by a mass of observational and experimental evidence. A steelhead is a sea migrant

\*Until his death in March, 1949, Dr. Hildebrand was senior ichthyologist of the Fish and Wildlife Service.

of the particular species inhabiting the stream, and in our waters (California) it may be either a cutthroat steelhead or a rainbow steelhead, and there is no occasion to apply a Linnean binomial name to a steelhead as such." (Underscoring curs). Another snarl that has caused, and still causes ichthyologists much trouble is the inadequacy of some of the early descriptions. Thus, the coast rainbow, which often has carried the scientific name, Salmo gairdnerii, was designated Salmo irideus by Snyder (1940, p. 123), because he was unable to identify any particular species, with the original description of S. gairdnerii, which in fact may have been based on a salmon.

The very close relationships, the apparent depletion or extermination of some species, the hybridization of others through artificial culture and distribution, together with inadequate taxonomic study, make it impractical to offer keys and descriptions of the various species, subspecies and varieties. The situation is well stated by Snyder (1940, p. 123), who already has been quoted, "As in the case of some peoples, American Indian and Asiatic Mongol for example, so with trouts, cutthroat and rainbow alike, the distinguishing traits which separate them are difficult to set down in writing. Yet when one becomes familiar with them they may usually be recognized with certainty. The shape of the head and body, the dentition, the red throat mark, the squamation, the habits, etc., are not in each case always to be depended upon. Large acquaintance with them will demonstrate the futility of attempting an identification of their species by means of artificial keys or brief descriptions." It is to be noted that Prof. Snyder even found difficulty in stating the difference between what he designated (p. 99) the "rainbow series" and the "cutthroat series," notwithstanding that he recognized several species in each series.

As it is impractical to offer descriptions of species of trout here, only the names of the usually recognized forms, together with their natural distribution, as far as known, are given.

In general, it may be said that the salmon family, of which the trouts are members, is composed of soft-rayed fishes, that is, the fins are without spines. The paired fins, corresponding to the hind limbs of higher vertebrates, known as the ventral or as pelvic fins, are attached to the abdomen, far behind the other pair of fins that corresponds to the fore limbs of higher vertebrates, known as pectoral fins. On the back, well behind the moderately large rayed dorsal fin, is a small fleshy rayless fin, called the adipose fin. The salmon in zoological classification, though they are teleosts, that is, bony fishes, are considered as of a rather primitive order, higher than the sharks with their primitive cartilaginous skeletons, but lower than the more specialized fishes,

such as the basses and cods for example, which possess very complex bony skeletons. However, the trouts, at least, have specialized in color, wherein some of them rival the most brilliant hues of fishes of tropical seas.

Trout resemble salmon superficially, but differ in many respects. The surest way to separate them is by the shorter anal fin situated behind the vent. In the trout this fin has 12 or fewer rays, whereas in the Pacific salmon it has 13 to 16 or more rays. The trout, in general, are more slender and graceful fish than the salmon.

The trouts are divided into three groups or genera. The largest genus, Salmo, includes the rainbow, the cutthroat (and steelheads), and the Atlantic salmon with its landlocked relatives, and an introduced European species, generally known as the brown trout. Three species or groups of species, belong to this genus, which is characterized by having black spots; by the moderately large scales, generally fewer than 200 in a lateral series; and by having a more fully toothed vomer than the other genera.

The smallest genus is Cristivomer, which contains only the Great Lakes trout or Mackinaw trout, with perhaps one sub-species. This genus is readily recognized by its deeply forked tail, gray spots, absence of bright colors, and with 200 or more scales in a lateral series.

The third genus, Salvelinus, includes species related to European species that are known in Britain as charrs, consisting of the eastern brook trout, the Dolly Varden trout, the Greenland charr, and what perhaps may be regarded as sub-species of the charrs named, several of which have been recognized by some authors. The species of this genus generally have red spots, the lower fins have bright white edgings, and the scales are very small, and usually so deeply imbedded in adults as to escape notice.

The genus Salmo in the western states is composed of two groups or series, which have been designated as the "rainbow" series" and the "cutthroat series" by Snyder (1940, p. 99). On the northern Atlantic seaboard and slope this genus is represented by the Atlantic salmon, and its landlocked relatives. In addition to these native species the introduced European brown and Lock Leven trout are now widely distributed in the United States.

#### THE RAINBOW SERIES

The rainbow series is characterized by having rather large scales, generally about 140 to 160, though a few species are said to have as many as 200, in a lateral series. Black spots as a rule are rather

scattered, and in a few forms the back is so dark as to obscure them if present. Finally there is no red streak on the trout, that is, beneath the mandible, as in the cutthroat series. The last mentioned character generally separates the two series at a glance.

The "leading species" of the rainbow series, following the nomenclature of Prof. Snyder (1940, p. 123), is Salmo irideus. This is the leading species in the sense that its description and name apparently are the oldest that can be definitely assigned to a rainbow trout. A rather large number of nominal species has been described in the rainbow series, regarded variously as species, subspecies, varieties or races by authors. The populations have not been studied to a sufficient extent to determine adequately their precise status in classification. Some of them probably are only color phases resulting from the particular environment in which the specimen or specimens studied lived. Rainbow trout, in one form or another, have been reported from as far north as Bering Sea and southward into the mountains of northern Lower California. Through fish culture the range has been greatly increased, as rainbow trout have been planted in nearly all suitable waters of the United States and in many foreign lands.

The names that follow, though the list is not complete, have been more or less definitely assigned to trouts that appear to belong to the rainbow series. Most of them no doubt apply only to local varieties or races such as exist, though generally in a less pronounced form, in species of many fresh water fishes from different river systems. However, others may apply to distinct species. The original describer, the date and place of publication, and the locality from which each nominal species was described is stated.

Salmo irideus Gibbons (Proc. Cal. Acad. Sci., I, 1855, p. 35, San Leandro Creek, Alameda Co., Cal.). The name S. gairdnerii Richardson (Fauna Borealis-Americana, III, 1836, p. 221) long was used for the coast rainbow and steelheads. However, it was discarded by Snyder (1940, p. 123), because he was unable to identify any trout with certainty from the original description, which in fact may have been based on a salmon. As S. gairdnerii does not seem to be available, S. irideus becomes the correct name of the coast rainbow, which according to Snyder (1940, p. 101) includes the so-called steelhead in part.

Salmo stonei Jordan (Thirteenth Biennial Rept. Cal. Fish Com., 1894, p. 142, McCloud River at Baird, Cal.) according to Snyder (1940, p. 125) is the Shasta trout, and is identical with S. shasta Jordan. This is the trout that received early attention by fish-culturists. Later the coast rainbow also was hatched, and the two apparently have become hybridized. The artificially hatched fish have been widely distributed in the United States and foreign lands.

Salmo gilberti Jordan (Thirteenth Biennial Rept. Cal. Fish Com., 1894, 143, Kern River at Soda Springs, Cal.) is the Kern River trout, which supposedly is limited in its distribution to the Kern River, Cal.; but is now probably extinct in its pure form.

Salmo aqua-bonita Jordan (Pro. U. S. Nat. Mus., XV, 1892, p. 481, type from Cottonwood Lakes on the east side of Mt. Whitney into which the species had been introduced), has as its natural habitat the South Fork of Kern River and Volcano Creek, Cal. This is the brilliantly colored golden trout, and presumably is identical with S. roosevelti Evermann (Bull. U. S. Bur. Fish., XXV, 1905 (1906), p. 26, Volcano Creek, Kern River Basin, Cal.).

Salmo whitei Evermann (Bull. U. S. Bur. Fish., XXV, 1905 (1906), p. 20, south fork of Kaweah River, Cal., into which it had been introduced) has as its natural range Soda Creek, Coyote Creek, Wet Meadow Creek and Little Kern River. This is another Golden trout, and probably not specifically distinct from the preceding one.

Salmo rosei Jordan and McGregor (Proc. Acad. Nat. Sci. Phila., LXXVI, 1924, p. 19. Lake Culver, Cal.) is called the Culver Lake trout after the lake in which it lives. *Stocked*

Salmo evermanni Jordan and Grinnel (Proc. Biol. Soc. Wash., XXI, 1908, p. 31, south fork of Santa Ana River, at an elevation of 8,200 feet, four miles northwest of San Geronio Peak) has been designated the San Geronio trout. According to Snyder (1940, p. 129) it may have become extinct due to the invasion of its habitat by rainbow and brown trout. *- cutthroat*

Salmo aquilarum Snyder (Bull. U. S. Bur. Fish., XXXV, 1915-16 (1917), p. 77, Eagle Lake near mouth of Pine Creek, Modoc Co., Cal.) is limited in its habitat to Eagle Lake and its tributary stream, Pine Creek. It is appropriately called Eagle Lake trout.

Salmo regalis Snyder (Bull. U. S. Bur. Fish., XXXII, 1912, p. 26, Lake Tahoe near Broadway, Nev.) is the royal silver trout, inhabiting Lake Tahoe.

Salmo smaragdus Snyder (Bull. U. S. Bur. Fish. XXXV, 1915-16 (1917), p. 80, fig. 9, Pyramid Lake, Nev.) is the emerald trout, inhabiting Truckee Basin, Nev., and is related to the preceding species.

Salmo nelsoni Evermann (Proc. Biol. Soc. Wash., XXI, 1908, p. 26, Pl. I, San Ramon River, San Pedro Martir Mountains, Lower Cal.) is designated "Lower California trout" in literature. It is said to be related to the Kern River trout, S. Gilberti.

Salmo kamloops Jordan (Forest and Stream, Vol. 39, No. 19, 405, 1892) was originally described from Kamloops Lake in British Columbia and has been transplanted to other bodies of water. It reaches a large size and is highly esteemed as a game fish.

#### THE CUTTHROAT SERIES

The cutthroat series is distinguished from the rainbow series by Prof. Snyder (1940, p. 100) as follows: "The cutthroats are characterized by having smaller scales, more numerous black spots, and usually a red streak beneath the mandible, from the presence of which their name is derived." It may be added that there is much variation and overlapping between this series and the rainbow series in respect to the number of scales in a lateral series, as well as in the abundance of black spots.

The leading species, that is, the one first described, among the outthroat trouts is Salmo clarkii. The remarks concerning species, subspecies, varieties, etc., of the rainbow series, made on a preceding page, apply equally as well to the outthroat series.

Cutthroat trout have been reported from coastal streams from British Columbia to Redwood Creek in Northern California. They also occur in the eastern drainage of the Sierras, and in the Colorado River.

The names that follow, though the list is not complete, have been more or less definitely assigned to the outthroat series.

Salmo clarkii Richardson (Fauna Borealis - Americana, III, 1836, p. 225, Cathlapootl River, Oregon) is the coast outthroat trout. It is a native of the coastal streams from British Columbia to Redwood Creek, Cal., and according to Snyder (1940, p. 101) it includes the steelhead trout, in part.

Salmo henshawi Gill and Jordan, in Jordan (Manual Vertebrates, Ed. 2, 1878, p. 258, Lake Tahoe) has been called the Tahoe outthroat trout after the lake from which it was first described. Besides Lake Tahoe it is found in Pyramid, Truckee, Webber, Donner, and Independence Lakes, and in most streams in the eastern slope of the Sierra Nevada. Salmo tahcensis Jordan and Evermann (Bull. U. S. Nat. Mus., Pt. III, 1898, p. 2870, Lake Tahoe) according to Snyder (1940, p. 133) is a synonym.

Salmo seleniris Snyder (Cal. Fish and Game, XX, No. 2, 1934, p. 105, Fish Valley Alpine Co., Cal., east of the Sierra Divide) has been designated "Plute trout." It is restricted to small streams above Llewellyn Falls in Silver King Creek, Cal.

Salmo pleuriticus Cope (Hayden's Geol. Surv. Mont., 1871 (1872), p. 471, headwaters of Green River, Wyo.) is the Colorado River trout, to which its natural distribution seems to be confined.

Salmo lewisi Girard (Proc. Acad. Nat. Sci. Phila., VIII, 1856, p. 219, Falls of Missouri River) often is designated the Yellowstone trout. It inhabits Yellowstone Lake, the upper Missouri, and the middle and upper Columbia drainage. Its range has been somewhat extended through artificial propagation and distribution.

Salmo utah Suckley (Monogr. Salmo, 1861 (1874), p. 136, Utah Lake) is known as the cutthroat trout of Utah Lake, and is reported from the lakes and streams west of the Wasatch range, in Bear, Provo, Jordan and Sevier Rivers, as well as Utah Lake.

Salmo virginalis (Girard) (Proc. Acad. Nat. Sci. Phila., VIII, 1856, p. 220, Utah Creek and at Sangre de Cristo Pass, Colo.) is the Rio Grande trout, which is said to range from the upper Rio Grande southward into the mountains of Chihuahua, Mexico.

Salmo stomias Cope (Hayden's Geol. Surv. Wyo., 1870 (1871), p. 433, South Platt River, locality unknown) the green trout, is reported from the headwaters of the Arkansas and Platt Rivers.

Salmo macdonaldi Jordan and Evermann (Proc. U. S. Nat. Mus., XII, 1899 (1890), p. 453, Twin Lakes, Cal.) is designated the yellowfin trout, and is found in the headwaters of the Arkansas River.

The following are related to, and probably scarcely distinct from Salmo clarkii: S. jordani Meek (Pub. Field Col. Mus., Zool. Ser., I, 1897 (1899), p. 229, Lake Southerland, Wash.); S. declivifrons Meek (ibid., p. 230, Lake Southerland, Wash.); S. bathoecetor Meek (ibid., p. 227, Crescent Lake, Wash.); S. crescentis Jordan and Beardslee (Proc. Cal. Acad. Sci., 2d ser., VI, 1896, p. 207, Crescent Lake, Wash.); S. beardslei Jordan and Seale (Proc. Cal. Acad. Sci., 2d ser., VI, 1896, p. 209, Crescent Lake, Wash.); S. gibbsii Suckley (Ann. Lyc. Nat. Hist. N. Y., VII, 1858, p. 1, Fort Dallas, Columbia, Yakima, John Day and Boise Rivers).

#### THE ATLANTIC SALMON AND LANDLOCKED RELATIVES

The Atlantic salmon, in contrast with the other members of the genus, have the vomerine teeth little developed, and the scales are large, generally fewer than 120 in a lateral series. Although these fish are popularly known as salmon, morphologically they are trout, and are so classified.

The Atlantic salmon, Salmo salar, was described very early. It has been designated the type of the family Salmonidae, and it is also the type of the genus Salmo. Several nominal American species related to S. salar, the Atlantic salmon, have been described. However, the late Dr. William C. Kendall, in his Fishes of New England (1935, p. 116) recognized only one species, namely, the lake salmon, more usually referred to as the landlocked salmon, S. sebago. Concerning the distinguishing characters of the Atlantic salmon and the lake salmon he said, "While there are a few single structural characters which will usually enable one to identify his fish, if he knows what these characters are, the real recognition character is the fish itself. The lake salmon embodies a different ensemble of proportions from that of the sea salmon. These proportions are variable in fish of different sizes, ages and sexes. In other words, the general make-up of the lake salmon is different from that of the sea salmon. Correlated with that difference is the difference of habits, habitat, and physiology, and these are inseparable in each." Dr. Kendall offered tables of proportions and enumerations from which it may be concluded that only average differences exist. The most important one is the proportionate depth of the caudal peduncle, stated as follows (p. 137):

"Average for the least depth of the caudal peduncle not over 73 percent of the distance from the adipose to the base of caudal and not over 66 percent of the distance from the anal to caudal ---Atlantic salmon (Salmo salar).

"Average for the least depth of the caudal peduncle more than 73 percent of the distance from the adipose to the base of caudal and more than 66 percent of the distance from anal to caudal -- Lake salmon (Salmo sebago)."

*Howatow*  
Salmo salar Linnaeus (Syst. Nat. Ed. X, 1758, p. 308, seas of Europe) is the common Atlantic salmon, and is known from both coasts of the north Atlantic, originally extending at least as far south as Delaware on the American side; now depleted in the United States and only occasionally taken as far south as Cape Cod.

Salmo sebago Girard (Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 380, Sebago Lake, Me.) has been designated the lake salmon by Kendall (1935, p. 104), though it is more generally known as the landlocked salmon. It is reported by this author (1935, p. 106) as inhabiting waters in eastern North America within the latitudinal range of the sea salmon, though found within these limits from disconnected localities.

## BROWN TROUT

Salmo trutta Linnaeus (Syst. Nat. Ed. X, 1758, p. 308, Europe) is the brown trout of Europe which was introduced by fish culturists, together with the Lock Leven trout, Salmo levenensis, which if originally actually distinct from the brown trout seems to have become hybridized with it in America, leaving no clear distinction. The brown trout has been widely distributed in the United States.

## THE GREAT LAKES TROUTS

The Great Lakes trouts are readily recognized by their gray spots, lack of bright colors, and by the deeply forked tail.

Cristivomer namayacush (Walbaum) (Artedi Pisc., 1792, p. 68, Hudson Bay) is called the Great Lakes trout, Mackinaw trout, namayacush, masamacush, longue, and tongue. Its range includes the Great Lakes region, lakes of northern New York to Maine, the headwaters of the Columbia and Fraser Rivers, streams of Vancouver Island, and northward to the Arctic Circle, possibly introduced in the West.

Cristivomer siscowet (Agassiz) (Lake Superior, 1850, p. 333, Lake Superior) the siscowet trout, a subspecies or variety of the Great Lakes trout, is reported from deep water of Lake Superior.

## THE CHARRS

The charrs of North America belong to the genus Salvelinus. The word charr is an Anglo-English word that is seldom used in American English, except in books. The American name is brook trout. They are recognized by their extremely small scales, 200 to 350 in a lateral series, often embedded in large specimens; by the red spots (not black or gray); and by the white edgings of the lower fins. The body often is mottled above. Although several nominal species have been described, few are recognized by modern authorities.

Salvelinus fontinalis (Mitchill) (Trans. Lit. Phil. Soc. N. Y., I, 1815, p. 435, near New York City) is the brook trout, also known as Eastern brook trout, and as the speckled trout. It ranges from Saskatchewan and Labrador south to the headwaters of the Savannah River, and has been widely distributed by fish culturists.

The following probably are subspecies or varieties of the brook trout: Salvelinus agassizii Garman (Nineteenth Rept. Mass. Fish Comm., 1855, p. 20, Dublin Pond, N. H.); S. aureolus Bean (Proc. U. S. Nat. Mus., X, 1887, 628, Sunapee Lake, N. H.); S. timagamensi Henn and Rinkenbach (Annal. Carnegie Mus., XVI, 1925, p. 131, White Pine Lake, St. Lawrence Basin, Ontario); S. Oquassa (Girard) (Proc. Boston Soc. Nat. Hist., IV, 1854, p. 262, Oquassa or Oquossoc Lake, Me.); and S. marstoni (Garman) (Science, July 14, 1893, p. 23, Lac de Marbre, Ottawa County, Quebec).

Salvelinus stagnalis Fabricius (Fauna Greenlandica, 1780, p. 175, Alpine ponds of Greenland) the Greenland charr, is known from Labrador to Greenland, and possibly beyond these regions.

It is probable that the following nominal species are only subspecies or varieties of the Greenland charr: Salvelinus rossii (Richardson) (App., Ross's Voy., LVI, 1835, and in Fauna Borealis-Americana, III, 1836, p. 163, Regent's Inlet, Boothia Felix); S. naresi (Gunther) (Proc. Zool. Soc. London, 1877, p. 476, fresh water lakes near Discovery Bay); and S. arcturus (Gunther) (ibid., p. 294, Victoria lake, Floeberg Beach).

Salvelinus malma (Walbaum) (Artedi Pisc., 1792, p. 66, Kamchatka) is the Dolly Varden trout of the Pacific slope of America. Its general range, assuming that S. spectabilis (Girard) is only subspecifically distinct, extends from Kamchatka to the upper tributaries of the Sacramento River, California.

Salvelinus spectabilis Girard (Proc. Acad. Nat. Sci. Phila., VIII, 1856 (1857), p. 218, Ft. Dallas, Oreg.) apparently is a variant of S. malma, the Dolly Varden trout of America. Several other species have been named which apparently are not valid.

#### HABITATS OF TROUT

Clear cool streams and lakes, with the temperature of the water below 70°F., are the chief abode of trout. However, some species such as the Atlantic salmon and the coast rainbow and coast cutthroat habitually descend to the sea for a part of their lives. Others, like the eastern brook trout and the Dolly Varden trout, run down to the sea only in the northern parts of their range. Still others spend their entire lives in fresh water, either because they are land-locked, or from choice.

Barriers erected by man in streams have interfered with the migration of those species that habitually run out to sea, and later return to spawn. This interference with migration, and the pollution of streams and lakes, have caused a decline, or even the extermination of trout in some waters.

## FOOD OF TROUT

Trout are carnivorous, feeding chiefly on insects, both adults and larvae. However, they take many other foods also, including fish eggs, and young fish of many kinds. It has been said that they feed on "anything that moves and some things that do not," seeking food anywhere between the bottom and the surface.

## SPAWNING

The favorite spawning grounds of the trout are gravelly areas in swiftly flowing streams. Most species spawn during the autumn or winter. The eggs are relatively large, and by comparison with many other fishes few in number, requiring a comparatively long time, six weeks more or less, to hatch, the incubation period being greatly lengthened by low temperatures and shortened by higher ones. The young, as they emerge from the egg, carry a large yolk-sac upon which they subsist for quite a long time. However, when the yolk is all absorbed the fish in nature must find their own food. This is a very critical stage of life, for if food of the proper kind and size is not at hand the fish perish.

Natural reproduction among several species of trout, as indicated elsewhere, has been aided by artificial culture. No other group of fish has received so much attention by the fish culturist.

## GROWTH, AGE AND SIZE ATTAINED

Trout, like other fish, grow fast if an abundant supply of food is obtainable, if the environment in other respects also is favorable, and becomes stunted if the reverse is true. The age and rate of growth of any individual can be fairly accurately determined, by an experienced investigator, from the scales. If the rings on the scales are far apart rapid growth is indicated; if close together growth has been slow. During the winter, when growth is greatly retarded, the rings become crowded and form what is known as an "annulus." The investigator determines the age of the fish from the number of annuli on the scale.

It is, of course, understood that all species of trout do not grow equally large. The eastern brook trout and the Dolly Varden Trout generally run small, usually not much more than 12 to 15 inches in length. Yet, tremendously large individuals, weighing 10 to 14 pounds, have been reported. Rainbows weighing upward of 20 pounds, and outthroats of 40 pounds or so have been taken. Atlantic salmon weighing 70 to 100 pounds, and Great Lakes trout weighing 50 to 80 pounds, have been caught. Of course, fish of the sizes stated are exceptions. The average weight of individuals of these species, taken by anglers, probably does not exceed an eighth and in some cases not a tenth of the weight given.

## COLOR

Adult trout of most species, particularly when approaching the spawning season, are brilliantly colored. Young trout, to the contrary, are relatively plain, except for dark bars or blotches on the side, known as "parr marks." As many as 10 or 12 marks may be present in some species. They sometimes persist for two or three years, and occasionally remain in adults. Color markings, as shown elsewhere, are important in recognizing species.

## GAME AND FOOD QUALITIES

All species of trout are game fishes, and, exclusive of the Great Lakes trout and the Dolly Varden trout, are protected in United States waters as such. In game qualities all species are not equally good. The eastern brook trout is regarded by some as among the best of all game fishes. The related Dolly Varden trout of the west, on the other hand, is not highly regarded as a game fish. It is said to be a bit slow in taking the bait, and not overly demonstrative when hooked.

The quality of the flesh, although ranking high as a whole, is claimed to vary among species. Again the eastern brook trout ranks as near the best, and is considered by some anglers as superior to the rainbow trout.

Sport fishing always has ranked high as a wholesome pastime. The trout, of course, are valued chiefly as sport fish, and as already stated are propagated, protected and reserved, with few exceptions, for that purpose. Great refinement of apparatus and technique for trout fishing has been achieved. Much has been written on the merits of different kinds of lure, and on how to fish. Scarcely two authors agree, which perhaps is fortunate as that leaves it to the initiative of each angler to perfect his own apparatus and technique, which after all makes the sport more interesting.

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