

2.—A REPORT UPON INVESTIGATIONS MADE IN TEXAS IN 1891.

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This paper is a report upon the investigations made by the U. S. Fish Commission in the State of Texas in November and December, 1891, as contemplated in an act of Congress, approved March 3, 1891, providing "For investigating respecting the advisability of establishing a fish-hatchery station in the Rocky Mountain region in the State of Montana or Wyoming, and also in the Gulf States."

The character of the station which it is desired to establish in this region is indicated in the memorandum of instructions furnished me by Col. Marshall McDonald, the Commissioner of Fish and Fisheries, viz:

It is desirable, if practicable, to unite in one station the facilities for fish-cultural work with the salt-water species, for the pond culture of fresh-water species, for the investigation and development of methods for the propagation and rearing of the oyster, and for the investigation of the marine life of this coast. This means, of course, a laboratory of marine biological research, not large or expensive, but thoroughly equipped in all respects for its work. It is not necessary that all these requirements should be found at one locality, but they should be so closely and conveniently associated as to be brought under one direction. The requirements for each of the above classes of work may be briefly indicated as follows: For marine research and for hatching there will be required a suitable site above the chance of damage by storm or tide, with available supply of salt water. For the study of methods of oyster-culture will be needed an area of 100 to 200 acres of low-lying marsh lands, on the coast line, easily convertible into storage and rearing ponds. If this lies on the banks of a landlocked bay, from which the salt water may be conducted by canals into the ponds and which is not subject to roiling by storms, this is of course desirable.

If the requisite conditions for such a composite station could not be found sufficiently closely associated, I was instructed to make investigations in the interior of the State looking toward the selection of a site suitable for the culture of fresh-water species alone.

The requirements for the culture of fresh-water species of fish for this region are, briefly:

1. A constant supply of about 1,000 gallons of pure water per minute.
2. Not less than 20 to 30 acres of land. This land should lie so that the water may be obtained from the source of supply by means of gravity if possible. The land should be of such a character as to render the construction of ponds upon it an easy matter, and the fall should be sufficient to permit the ready drainage of any one of the series of ponds whenever occasion requires. Furthermore, there should be no danger of contamination from freshets or other causes.
3. The location should afford good railroad facilities.

The determination of the abundance, condition, and definite range of each and every species of fish and the character and abundance of their food supply is a question not only of great scientific interest but one of the utmost economic importance in its bearing upon the intelligent and successful propagation of useful food-fishes. The physical, chemic, and biotic forces which go together to constitute the fish environment of any given stream must be clearly understood before that stream can be intelligently stocked with any additional species. These forces may be so adjusted as to render the introduction of the proposed species fatal to one or more kinds of valued food-fishes already found in the stream; or, on the other hand, the great abundance of some indigenous species of carnivorous fish might render it impossible for the species which it is proposed to introduce to ever become well established.

In carrying out my instructions visits were made to Galveston and Corpus Christi, on the coast, and Houston, Palestine, San Antonio, New Braunfels, San Marcos, Austin, and Fort Worth, in the interior. It is believed that the investigations at Galveston and Corpus Christi are sufficient to determine whether the coast affords any suitable location or not, and so many excellent locations for a fresh-water station were found in the interior as to render further explorations unnecessary.

On the whole, it may be said that no point on the coast examined offers entirely satisfactory conditions for the establishment of a combined fresh and salt water station, but the Swan Lake site, near Galveston, might prove fairly suitable.

It was intended to make a careful study of the Trinity River Basin, giving attention to the various streams in this drainage area; the nature and volume of the water of each; the general character of the vegetation, both in the streams and along the banks; the geologic features of the country; the character and abundance of the fish found in each stream, and the presence of crustacean and other life in the waters which may serve as food for fishes. Wholesome work of this character was done on the Trinity River, inclement weather necessitated the deferment of its completion.

Temperatures were taken with a Wilder's standard thermometer and are given in Fahrenheit degrees. The seining was done with Baird collecting seines of small size, except at Galveston and Corpus Christi, where we availed ourselves of the services and larger nets of the local fishermen.

ACKNOWLEDGMENTS.

I desire to make mention of the many courtesies shown us by the citizens of the various places visited by us. At Galveston we were assisted greatly in our work by the kind and thoughtful attention of many of the most prominent citizens of that place, among whom I should mention especially Mr. Fred. McC. Nichols, Mr. F. L. Dana, the secretary of the board of trade, and Mr. Julius Runge, president of the Galveston Packing Company. Through the kindness and hospitality of Mr. Nichols, we were enabled to visit several of the artesian wells on the mainland and to make a careful exploration of Dickinson Bayou.

At Houston our party received many courtesies from Maj. M. Looscan, Maj. A. C. Herndon, and Mr. Geo. A. Bringhurst, all of the board of trade, and from Messrs. Robert E. C. and Harvey T. D. Wilson. Through the kindness of these gentlemen we were enabled to make very careful investigations in Harris County.

At San Antonio we were assisted in visiting the springs by Mr. Joseph Hettler,

park commissioner of that city. At Austin, Mayor John McDonald, Mr. J. B. Lubbock, ex-State fish commissioner, and other gentlemen extended us facilities which aided us materially in our investigations there. We are also indebted to Mr. John A. Grant, third vice-president and general manager of the Texas and Pacific Railroad, and to officials of the International and Great Northern Railroad, for various favors.

ITINERARY.

I left Washington, District of Columbia, October 25, and proceeded to Neosho, Missouri, where I was met by the Commissioner, Hon. Marshall McDonald, and Dr. J. T. Scovell, of Terre Haute, Indiana. After spending three days, acquainting ourselves with the workings of the Government fish-hatchery at Neosho, we proceeded to Galveston, Texas, where we arrived November 2. The Commissioner left for Washington on November 4, and on the same day we were joined by Dr. R. R. Gurley, of the U. S. Fish Commission. We remained at Galveston and vicinity until November 15, when we went to Houston. On November 16 and 17 we examined Buffalo Bayou at various places, and Big White Oak Bayou near the city. On the 18th we drove to Sims Bayou, and the next day we went by rail and wagon to Clear Lake, near Websterville. On November 22 we went to Palestine, and during the next three days examined Trinity River, Long Lake, and Neches River, in that vicinity. We were joined here by Mr. J. A. Singley, of the Texas State Geological Survey, he having been directed by the State geologist, Dr. E. T. Dumble, to accompany us for the purpose of studying the molluscan fauna of the State. On November 26 we went to Corpus Christi, where we remained until December 1, upon which date we went to San Antonio. Remaining one day at San Antonio, we next visited New Braunfels, San Marcos, and Austin, spending one day at each place. From Austin we went to Fort Worth on December 6, where we remained one day. Owing to the unusually cold and disagreeable weather it was thought advisable to close the work here.

WATERS EXAMINED.

The following is a classified list of the waters examined:

I. *Galveston Bay*:

1. Highland Bayou.
2. Dickinson Bayou.
3. Swan Lake.
4. Clear Lake and Creek.
5. Buffalo Bayou.
 - (a) Sims Bayou.
 - (b) Big White Oak Bayou.
 - (c) Hunter Creek.
 - (d) Kilper's Ponds.
6. San Jacinto River.
7. Trinity River.
 - (a) Long Lake.

II. *Neches River*.III. *Corpus Christi Bay*:

1. Nueces River.

IV. *San Antonio River*:

1. San Antonio Springs.
2. San Pedro Springs.

V. *Guadalupe River*:

1. Comal Springs.
2. Comal Creek.
3. San Marcos Springs.
4. San Marcos River.
5. Rio Blanco.

VI. *Colorado River*:

1. Barton Spring.
2. Barton Creek.

REPORT OF THE INVESTIGATIONS.

GALVESTON BAY.

Investigations were made at various places in the vicinity of Galveston for the purpose of determining whether the conditions necessary for the culture of fresh-water fishes, salt-water fishes, and cysters could be found combined in one place. This, of course, means a location on or near the bay where salt water can be gotten under control and where fresh water can also be obtained. With this object in view visits were made to Dickinson, Fairwood, Hitchcock, and Highland, all on the mainland across the West Bay from Galveston; to Swan Lake and Moses Lake, on the mainland northwest of Galveston; and to South Galveston on the island.

FRESH WATER.

The only possibility of obtaining fresh water at any of these places is by means of artesian wells. There are not fewer than sixteen artesian wells on the mainland in the vicinity of Dickinson, Highland, Hitchcock, and Fairwood. The deepest of these is 768 feet, and the most shallow about 80 feet.

One well at the Ramie experimental farm on the Nicholstone estate, having a 2-inch strainer, flows 40 gallons per minute. The temperature of the water is 78°.

Another well near Dickinson flows about 25 gallons per minute; temperature, 78°.

At Fairwood is a well 576 feet deep, with a 2-inch strainer, which flows not less than 52 gallons per minute. The temperature is 78.5°. No analysis of this water has been made, but it is palatable and seems approximately pure. There is some carbureted hydrogen and a trace of iron.

Judge Wheeler's well, near Hitchcock, is 768 feet deep, has a 2-inch strainer, and flows about 48 gallons per minute. The temperature is 78°.

The Tacquard well, near Hitchcock, is 710 feet deep, has a 2-inch strainer, and flows 100 gallons per minute. The temperature is 79°. The height to which the water will rise above the surface at this well was found to be about 20 feet.

The Gulf, Colorado and Santa Fé well at Hitchcock is 726 feet deep. It has a 5-inch strainer, 30 feet long, and flows 97,000 gallons per day, or 67 gallons per minute. An analysis made April 23, 1890, by W. D. Church, chemist for the Atchison, Topeka and Santa Fé Railroad, Topeka, gave the following results:

Organic matter.....	Trace.
Silica.....	.350
Alumina and oxide of iron.....	.250
Bicarbonate of calcium.....	3.499
Bicarbonate of magnesium.....	1.500
Bicarbonate of potassium and sodium.....	17.221
Sodium chloride.....	9.660
Total solids (grains) per United States gallon.....	32.480

The temperature at outlet of pipe was 79°; density, at 15° C., 1001.91.

The South Galveston well is 800 feet deep, and has a 3-inch pipe with a 2-inch strainer. It flows 37 gallons per minute, and the temperature of the water as it comes from the pipe is 79.5°. The density at this temperature was 1002, which, reduced to 15° C., gives 1004.24.

At Judge Wheeler's residence, near Hitchcock, a fish pond has been made which receives its water supply from the artesian well. Black bass and sunfish have been placed in this pond, where they seem to thrive very well. The water of the Wheeler well does not seem to differ materially from that of the other wells of this vicinity, and it is probable that such species of fresh-water fishes as would be cultivated at the station contemplated would do fairly well in ponds supplied from any of these wells.

I understand that water has been gotten in every place on the mainland where wells have been bored, so it is quite certain that water of this character could be obtained along the mainland in the vicinity of the bay. To obtain the requisite supply would probably require three or four wells sunk to a depth of over 700 feet, and each should have at least a 3-inch strainer.

SALT WATER.

Galveston Bay is shut off from the Gulf by Bolivar Peninsula and Galveston Island, between which is the Bolivar Channel. This channel is about 2 miles wide and is the entrance to the bay. The greatest length of the bay is from northeast to southwest, and is approximately 35 miles. The width between Bolivar Point and Swan Lake is about 7 miles. Above these points the bay widens out greatly, sending an arm known as East Bay to the eastward. Including East Bay, it is here not less than 27 miles wide. Above this it constricts again between Edwards and Smith Points, where it is less than 8 miles wide. Above Redfish Bar, lying between Edwards and Smith Points, is really the main part of the bay, the greatest width of which is about 14 miles, on a line running northwest from Smith Point to Morgan Point at San Jacinto Bay. Extending westward from the east end of Galveston Island, and separating it from the mainland, is West Bay. At the northeast end of the bay is a small bay known as Turtle Bay, shut off from the main bay by the delta of the Trinity River. At the northwest corner, lying above Morgan Point, is San Jacinto Bay, into which the San Jacinto River and Buffalo Bayou empty. About 10 miles down the west shore is the mouth of Clear Creek, the outlet of Clear Lake. Seven miles farther down is the mouth of Dickinson Bayou, just below which is Moses Lake; and 5 miles below this, or about 6 miles northwest from Galveston, is Swan Lake. Just north of Galveston, and between Swan Lake and Bolivar Point, are Pelican Spit and Pelican Island.

Through the greater part of the bay the depth of water is given as from 1 foot to 11 fathoms. According to the U. S. Coast Survey Chart (No. 204) of Galveston Bay—

There is usually one high and one low water here in each lunar day. The highest tides occur when the moon's declination is greatest, either north or south, and they are slightly increased when the greatest declination falls near the time of new or full moon. When the moon's declination is near zero, small tides usually appear twice a day for two or three days. The following table is made from average values:

Place.	Rise and fall of tides.		
	Mean.	At moon's greatest declination.	At moon's zero declination.
Galveston entrance	1.1	1.6	0.8
Pelican Spit	1.1
Redfish Bar	0.5

It is high water about seven or eight hours after the moon's meridian passage when the moon's declination is greatest south, and nearly twenty hours after when it is greatest north; but these intervals are uncertain by several hours. The effects of the winds are often greater than the real tides, and the time and the height of the apparent tides are greatly dependent on them.

The waters of Galveston Bay seem well adapted to the oyster. Oysters of good size and quality were seen about the wharves at Galveston, at Swan Lake, Moses Lake, Dickinson Bayou, Virginia Point, and other places.

The Galveston Packing Company was organized two or three years ago at Galveston for the purpose of developing the oyster industry at that place. This company has located 6,000 acres in the bay, principally in the vicinity of Pelican Island, of which they have planted 440 acres. Three thousand bushels of shells were planted upon one tract of 10 acres. Upon these shells a good set was obtained. These oysters were about eighteen months old at the time of our visit, and were very abundant and of excellent quality.

The density of the water here was 1021.66;* the temperature at surface, 72.5°, November 9, at noon.

Just off the outlet of Swan Lake the density was 1018.30; temperature at the surface at 10 a. m., November 10, 62°. Just inside of Swan Lake the density was 1017.30. Swan Lake is a shallow body of salt water, covering 600 or 700 acres. It has two outlets into the bay, one about 100 feet wide, the other about half as wide. Between these two narrow outlets is a low mud island which no doubt is flooded frequently at high tide. Oysters are quite abundant in this little lake, and we noticed two or three boats tonging oysters here. I paid special attention to this lake, as it seemed to present many of the conditions required for the station under consideration.

Swan Lake is quite shallow and, according to Mr. Parr, who lives upon the shore, is rapidly filling up. He says the lake is less than half as large as it was eighty years ago, when his father first settled upon it, and that it has decreased much in size during the last forty years, or within his own memory. The shores are, in the main, very low, particularly at the north end and on the east and southeast, where they are marshy. At the north end one or two small creeks flow into the lake, but I do not imagine the amount of water they carry in can be very great. At Mr. Parr's place, on the west side of the lake near the south end, the shore is several feet high, and apparently never subject to overflow. The greater part of the shore, however, is certainly flooded occasionally.

The low-lying land just north of Mr. Parr's, near the upper end of the west side of the lake, could be easily converted into ponds suitable for the study of methods of oyster-culture. Whether the water often becomes roiled I was not able to learn, nor do I know how injurious occasional flooding of the ponds would prove. Flood-gates could be constructed at the outlet of the lake by means of which the water coming in with the tide could be stored and fed out to the ponds between tides.

The tide is so little at this place that it could scarcely be depended upon for giving a gravity supply, consequently pumping would have to be resorted to. It is probable that water for the fresh-water ponds could be obtained by sinking artesian wells. These ponds could be constructed on the higher land near the south end of the lake.

*The density, as given in this report, is that of the water reduced to 15° C.

This location is about 3 miles from the railroad station at Virginia Point. It would seem to me that such a composite station as is contemplated could, with reasonable safety, be established in the vicinity of Swan Lake. The cost of getting sufficient water, salt and fresh, the doubt as to whether the artesian water would prove satisfactory, and the danger of flooding and roiling from storms, are questions that would have to be carefully considered.

The country in the vicinity of Moses Lake, Clear Creek, and Highland Bayou was also examined, but in no one of these places could the desired conditions be found, the danger of fresh-water flooding in each case being too great.

A visit was also made to South Galveston, on the island 10 miles southwest from the city of Galveston. At this point the South Galveston Land Company has recently struck water that seems fairly fresh. The depth of the well is 800 feet. With a 2-inch strainer the flow is 37 gallons per minute. The temperature of the water was 79.5°, and the density was 1004.24.

There is but little, if any, saline taste to the water, and it might prove suited to fresh-water fishes. There is considerable gas (probably CH_4) dissolved in this water, as was evidenced by the fact that a slight explosion was obtained upon applying a burning match at the end of the horizontal pipe through which the water was led from the well. Upon issuing from the pipe the water is quite murky, but very soon clears by the escaping of the contained gas or gases.

On the West Bay side of the island, a short distance from this well, are two narrow bays extending obliquely into the island. Each of these contains approximately 40 acres. The land adjacent to each is low, but probably high enough to prevent flooding, except during very heavy storms. Either of these small bays could be quite easily supplied with gates at the mouth and its water thus brought under control. Ponds could be constructed near them that would probably answer fairly well for oyster-culture. Higher ground can be found near by, suitable for the fresh-water ponds. Mr. Gray, the president of the South Galveston Land Company, says the company will give the Commission one of these bays and all the land it may need. This location does not seem as desirable, however, as the one at Swan Lake—the land not lying so satisfactorily and the water being less fresh than that which could probably be gotten at Swan Lake.

Mr. Fred Nichols offers a site near the mouth of Dickinson Bayou. The land there seems safe from overflow, and salt water could be gotten by pumping from the bayou. It is quite certain, however, that this bayou at times becomes too fresh for salt-water culture. Fresh water could be secured here, as elsewhere upon the mainland, by means of artesian wells. Mr. Nichols would no doubt donate all the land needed.

Dickinson Bayou.—This bayou is about 18 miles long and empties into Galveston Bay about 15 miles north of Galveston. In its lower portion its waters are salt except at the time of heavy rains, and the water is more or less brackish nearly throughout the course of the stream. The depth probably ranges from 4 to 18 feet. The water is rather warm and is stained more or less by vegetable matter in the stream. The current is sluggish and the banks and bottom are of mud in most places. The shores are low and are well covered with vegetation. There is a heavy growth of timber, the principal trees being several species of oak, elm, hackberry, ash, box elder, etc. The most characteristic and striking feature of the timber along Dickin-

son Bayou is the long moss (*Tillandsia usneoides*), which covers nearly every tree. In the immediate vicinity of Nicholstone the large oaks are magnificent with the long festoons of this interesting epiphyte. A number of small creeks or brooks flow into this bayou, but they are usually quite narrow and not deep. At the time of our visit they were nearly dry except here and there where were found pools 1 to 4 feet deep, filled with stagnant, bad-smelling water. These pools have muddy bottoms and are full of logs and snags.

In the lower part of the bayou are found many of the salt-water fishes of the bay together with oysters, shrimps, and many other salt or brackish water forms. In the upper portion were species of several genera of fresh-water fishes, such as *Micropterus*, *Lepomis*, *Ictiobus*, *Pimephales*, *Notemigonus*, and the like. In some places species of these fresh-water genera were found mixed with soles, *Gambusia*, and other Cyprinodonts.

This stream was examined at Nicholstone and for several miles both above and below that place.

Clear Creek is a stream very much like Dickinson Bayou. It rises in Harris County, south of Houston, and flows east to Galveston Bay about 7 miles above the mouth of Dickinson Bayou. Near its mouth it flows through Clear Lake, a small sheet of somewhat brackish water. Its banks are lined with a heavy growth of moss-covered oaks and other trees. Its fish life is essentially of the same character as that of Dickinson Bayou.

In Clear Lake, which is near the mouth of the creek, are found the various species of brackish-water fishes common to the region, and oysters are found in some parts of the lake.

Houston.—Considerable time was given to an examination of the waters about this city. It became readily apparent that the streams in the vicinity of Houston could not be depended upon for fresh water, as they are all more or less subject to sudden rises, when their waters become more or less muddy. The only stream we saw that is probably an exception to this is Hunter Creek west of Houston several miles. Excellent water, however, could be gotten by means of artesian wells, of which there is quite a number in and about Houston. One at the creosoting works is 670 feet deep. With a 6-inch pipe it flows about 100 gallons per minute. The temperature of the water at this well is 73°, and it is apparently fresh and suitable for fish. Another well, belonging to Mr. Jacob Kilper, in the western part of the city, was examined. Mr. Kilper has constructed a number of ponds here which are supplied chiefly from the artesian well. Carp that were placed in these ponds some years ago have done well. Eight or ten other species of fish have found their way into these ponds and seem to find the water satisfactory. Among these species are *Dorosoma cepedianum*, *Notemigonus chrysoleucus*, *Chaenobryttus gulosus*, *Lepomis pallidus*, and *Gambusia paruelis*.

About 3 miles southeast from Houston is a tract of land known as the Kownslar Place, lying on Buffalo Bayou, which would prove a very suitable site for the station should artesian water be considered satisfactory. This land lies about 25 feet above Buffalo Bayou and slopes very suitably for the purposes for which it would be used. The Texas Transportation Railroad runs within an eighth of a mile of this place, and an electric line will be built to it very soon. Should this land be deemed suited to our purposes I am assured by prominent citizens of Houston that it could be obtained on terms satisfactory to the Commission.

Buffalo Bayou.—This bayou heads in the western part of Harris County, flows eastward past the city of Houston, and empties into the northern part of Galveston Bay. In general, it may be said to be a rather narrow, sluggish stream, usually pretty deep, and navigable as far as Houston, to which place the effect of the tide extends. There is very little current, and the bottom is of mud full of snags. Throughout its entire course it flows through sand or clayey country, there being little or no hard rock anywhere. Indeed, wells sunk to a depth of 700 feet in this country do not strike any solid rock. The water is moderately clear and cool. The banks are well wooded, the principal kinds of trees being pine, cedar, oak, magnolia, elm, sycamore, etc. *Tillandsia usneoides* is not common here.

We fished Buffalo Bayou at Shepherd's dam, about $2\frac{1}{2}$ miles west of Houston or about 60 miles above its mouth. The stream at this place is about 20 feet wide and 3 feet deep. There are holes which are much deeper. The water was very low, as there had been no rains for some time. At times this stream is said to rise as much as 26 feet above low-water stage. We also fished at a point about 6 miles above Houston. Fish were quite abundant in this stream, both as to species and individuals. Such brackish-water genera as *Gambusia* and *Gerres* were found with such fresh-water forms as *Lepomis*, *Etheostoma*, *Aphredoderus*, and *Notropis*.

The temperature of the water at 11 a. m., November 17, was 61° ; air, 49° ; air at 8:30 a. m. was 45° .

Sims Bayou.—This is a small stream rising on the prairie southwest of Houston about 10 or 12 miles and flowing northeast to Buffalo Bayou, a few miles below Houston. The lower portion of the stream is lined on each side by a strip of timber, chiefly pine, while the upper part is through prairie land. This stream in dry weather becomes reduced to long, muddy pools. One of these which we examined was about 400 yards long, 10 to 40 feet wide, and 1 to $2\frac{1}{2}$ feet deep. During times of drought these pools supply drinking water to great numbers of cattle on the surrounding grazing lands, and as a result the banks and bottom are tramped and cut up and rendered very miry. The water is, of course, more or less foul. Its temperature at noon, November 18, was 58° , that of the air being 47° . At 6 o'clock in the morning the temperature of the air was 45° .

Fish were found to be quite abundant here, the most common species being the pirate perch, sunfish, war-mouth, and *Gambusia*. A few crawfish, turtles, frogs, and a small bivalve (*Sphaerium transversum* Say) were taken.

Big White Oak Bayou rises a few miles northwest of Houston and joins Buffalo Bayou at the town. It is a small creek which, at the time we saw it, was dried up into pools less than 10 feet wide and but a few inches deep. Oaks and other trees cover its banks. The bottom is muddy and full of snags. Not many species of fish were found here—minnows, suckers, and a few darters being the principal forms.

Hunter Creek is another small stream, a few miles in length, flowing into Buffalo Bayou from the north, about 8 or 9 miles west of Houston. This creek is very different from the other streams of this part of Texas, in that its water is exceedingly clear and rather cold. The temperature at 4 p. m., November 20, was 55° , the air being 70° . There is a good deal of limestone in the region through which it flows, and in this are numerous small springs whose uniting waters form the creek. The banks are usually rather high and steep, and are well wooded. The bed of the stream is 10 to 20 feet

wide, but the water is usually in pools 2 to 4 feet deep, connected by shallow reaches but a few inches in depth. Over these shallow reaches there is considerable current.

A good deal of *Chara* was seen in one large pool, and a few bunches of *Nuphar* were noticed. Logs and snags filled the stream. But few species of fish were found, the most abundant being *Notropis venustus* and *Micropterus salmoides*.

San Jacinto River.—This is a small river rising north of Houston and joining Buffalo Bayou at its mouth. In the mouths of these two streams and in San Jacinto Bay—the small arm of Galveston Bay into which they empty—are the chief fishing-grounds for the Houston market. Among the species from that locality seen in the market were buffalo, channel cat, fork-tailed cat, yellow cat, war-mouth, fresh-water drum, calico bass, big-mouthed black bass, yellow bass, and several species of sunfish. The amount of valuable food brought daily to Houston from this place is enormous. The number of pounds of the two species of *Ictalurus* greatly exceeds that of any other species.

Trinity River.—The Trinity is one of the most important rivers in Texas. It rises near the northern line of the State and flows in a very tortuous course for about 1,000 miles southeast to Galveston Bay, into the northern part of which it empties. The Indian name of this stream was Arkokisa, thought by some to be a corruption of Orquiasaco. La Salle called it the River of Canoes. We examined the Trinity River at Fort Worth, Dallas, Palestine, and Riverside. It is, through the greater part of its course, a rather sluggish stream, whose banks are moderately high and well wooded. We examined it most carefully in the vicinity of Magnolia Point, about 10 miles southwest of Palestine, November 23. At this place the stream was about 60 feet wide, 2 feet in average depth, and flowed with a 2-foot current. This indicates a discharge of about 14,400 cubic feet per minute. Both above and below Magnolia Point the current is less swift and the stream is deeper and wider. This is a very low stage of water, but during the spring rains, from March to May, the river rises very greatly, sometimes as much as 30 or 40 feet, thus rising above its rather high banks and flooding much of the adjacent land.

The shores are composed of sand and clay, with some ledges of sandstone and clay ironstone. This is especially the case on the left bank just below the ferry. In many places the shores are greatly eroded, forming numerous gullies or ravines coming down to the river. Generally the shores are covered with a pretty heavy growth of timber, willows of large size being most abundant. Besides these there are oaks, hickories, gums, and a few others. The bottom of the stream is muddy in some places, in others sandy or pebbly, and generally full of snags. The water is probably never very clear; its temperature at noon, when the air was 51°, was 53°.

The Trinity River is perhaps as good a fish stream as any of those of Texas flowing into the Gulf. We obtained no less than 30 species from it, the principal genera represented being *Leptops*, *Ameiurus*, *Noturus*, *Ictalurus*, *Ictiobus*, *Minytrema*, *Moxostoma*, *Notemigonus*, *Hybognathus*, *Hybopsis*, *Notropis*, *Phenacobtus*, *Oliola*, *Dorosoma*, *Zygonectes*, *Micropterus*, *Chænobryttus*, *Pomoxis*, *Lepomis*, and *Etheostoma*.

Long Lake.—A few miles below Magnolia Point is Long Lake. This is evidently a portion of a former bed of the Trinity River. It lies near the river and is a little over a mile in length and 100 yards in average width. During the dry season it is 12 to 15 feet deep in the deepest places. Its shores are 6 to 10 feet above the surface of

the water and are well covered with a good growth of small timber, chiefly post oak, with some hickory, gum, and mulberry. The bottom is of sand in most places, the north shore being a sandy beach sloping gradually to deep water. This small lake is well supplied with valuable food-fishes, and is a favorite fishing-place for the people of Palestine. Large-mouthed black bass, crappie, gaspergou, war-mouth, sunfish, channel cat, and buffalo are all abundant here. Crawfish, shrimps, and a large mussel (*Anodonta corpulenta*) were quite common.

NECHES RIVER.

This stream rises in the northern part of the State, near Canton, and flows southeast to Sabine Bay, into which it empties. It is much the same kind of a river as the Trinity, except that it is smaller. We examined the Neches River in the vicinity of the Palestine and Rusk Railroad Bridge, about 14 miles east of Palestine. Recent rains had put the river up out of its banks and made it about 300 feet wide and perhaps 8 feet deep. At low water it is here probably less than 30 feet wide. There was not much current and the water was muddy. The temperature of the water was 49.5° when that of the air was 63°. The banks are not high, and are of red clay and sand, there being some sandstone and clay ironstone in places. The banks are well timbered, oaks, pines, gum, and button willows being the most abundant. Collections were made in the river and in small ponds and a small branch near by. The fish found are essentially the same species as found in the Trinity River. A good many fresh-water shrimps and several crawfish were taken.

CORPUS CHRISTI.

Four days were spent at this place, but, as there seems to be no possibility of obtaining fresh water here, we did not examine the bay thoroughly. Corpus Christi Bay, however, and Matagorda Bay above it, are among the best oyster grounds on the Texas coast. Near the town is an oyster reef 3 miles long, which is used as a wagon road across an arm of the bay. The oysters on this reef are very abundant and of good quality. The Givens Oyster Company, organized at Corpus Christi about two years ago, is building up a large business. They obtain most of their oysters from Matagorda Bay.

SAN ANTONIO RIVER.

This river has its origin in a number of very large springs about 3 miles north of the city of San Antonio, upon the beautiful grounds of Col. Brackenridge. These springs come out in several places, close together, from a ledge of Cretaceous limestone. The minimum flow from the entire group of springs has been estimated at 22,500 gallons per minute, and the maximum at as great as 180,000 gallons. The average flow for the year is probably not less than 90,000 gallons per minute. The flow varies a great deal, and is said to be greatest following heavy rains in the Devil River region, 200 miles or more in the interior. The temperature of the water in all the springs of the group is about the same, being about 75° at noon, December 2. The water is very clear and, like all limestone water, appears blue in the deep places. The water from all these springs soon unites to form San Antonio River, a swiftly flowing stream, 20 to 40 feet wide and 2 to 8 feet deep.

Many species of water plants were found in the stream, certain kinds being very abundant in places. Suitable fish food, such as insect larvæ and small mollusks and crustaceans, appeared to be abundant. Among the mollusks noticed are *Physa halei*, *Limnæa desidiosa*, *Planorbis lentus*, and *Planorbis liedmanni*. One dead shell of a species of *Unio*, probably *Unio undulatus*, was found.

These waters seem well adapted to the usual species of fish of southern Texas, no less than a dozen species being found, among them black bass, sunfish, suckers, catfish, and eels. Crawfish were abundant.

About the springs and along the stream flowing from them is a heavy growth of trees, including oaks, elm, and pecan, the oaks being densely covered with *Tillandsia usneoides* and another beautiful epiphyte, *Tillandsia recurvata* Pursh.

There is another group of springs just in the north part of the city; these are called San Pedro Springs, and they flow perhaps half as much water as the San Antonio group. The ground about these springs belongs to the city and constitutes San Pedro Park, one of the most attractive of the numerous parks of San Antonio. The stream from San Pedro Springs, like that from San Antonio Springs, flows through the city, and the two come together south of the city.

The city gets its water supply from San Antonio Springs. Just below the springs are two pump-houses, where the water is pumped by water power to a reservoir a short distance east. This reservoir is said to be 150 feet above the city. To the north and west of the reservoir the land has a gradual slope down to the level of the river and lies in such a way as to make it a very suitable place for ponds. The water can be supplied from the reservoir and the ponds could be easily drained.

Just above the main group of San Antonio Springs is a small stream known as Olmos Creek, which is formed by numerous springs coming out along its banks. I did not learn of this creek until after leaving San Antonio, and was therefore not able to give it an examination, but I am informed by Mr. R. H. Russell, who is interested in the land, that, in his judgment, the conditions on Olmos Creek are very favorable. The land and water rights could probably be had here upon satisfactory terms.

GUADALUPE RIVER.

This stream is of moderate size, rising in southern central Texas and flowing southeast, by New Braunfels, to San Antonio Bay. We examined the Guadalupe in the vicinity of the wagon and railroad bridges near New Braunfels. The stream here is, at low water, from 75 to 150 feet wide and from 1 to 3 feet deep. The current is very swift in most places. The bed is in many places the Cretaceous limestone of the region; other reaches have the bottom covered with gravel; in a few places, where the current is less swift, there is some mud, and various pieces of *Alga* and other water vegetation occur here.

Like most all the streams of this part of Texas the Guadalupe is fed chiefly by numerous springs issuing from the Cretaceous limestone along its course. As a consequence the water is usually exceedingly clear. During heavy rains, when there is considerable direct surface drainage, these streams, of course, become muddy for a short time. The temperature of the water at 4 p. m., December 3, was 68°, the air being 58°. Such fishes as minnows, darters, sunfish, and catfish were fairly abundant. Crawfish were also found in considerable numbers.

The Comal Springs.—There are a great many springs in the vicinity of New Braunfels, the principal group being known as the Comal Springs. There are several springs in this group situated upon the land of Mr. Joseph Landa, a little over a mile northwest of New Braunfels. The largest of these flows, perhaps, as much as 50,000 gallons per minute, and is certainly a magnificent spring. The other springs of the same group flow at least as much more.

The main spring comes out near the foot of a limestone hill, and after running rapidly for a short distance over a pebbly bottom and in a narrow channel it widens out into quite a pond with mud bottom and filled with vegetation. This pond also receives the water from numerous other springs, and has its outlet in Comal Creek (or the Rio Comal), which, after a course of 2 or 3 miles, joins the Guadalupe River. The water of these springs is, of course, very clear. The temperature is 75°.

About 2 miles north of the town is another group of springs, smaller than that just described. The amount of water is abundant, however, and very suitable for fish-cultural purposes. Suitable land could be had in the vicinity of either of these clusters of springs, so situated as to enable the water to be gotten readily under control.

Fishes are very abundant in the Rio Comal and the small streams flowing from the various springs to form that stream. The species represented are the same as those found in the Guadalupe, already mentioned. Among the small mollusks found in and about these streams we noted *Planorbis bicarinatus* Say and *Goniobasis alexandrensis* Lea. Each of these was quite abundant.

San Marcos River.—This river and the springs in the vicinity of San Marcos were examined December 4. The river has its rise in a number of springs at the foot of a limestone ledge or hill just above the town. All these springs together form a large deep stream, from the bottom of which, near the upper end, wells up the principal spring. The water here is not less than 12 or 15 feet deep, and the water boils up with such force and in such enormous quantity as to keep the surface of the river visibly convex immediately over the spring. Some distance below a dam has been built, which furnishes power for running a large mill and for the electric-light plant of the town.

The temperature of the water here, like that in all the springs of this part of Texas, is about 75°. Many water plants are found in the stream, particularly above the dam, and such species of fish as the large-mouthed black bass, sunfish, and various species of Cyprinoids are abundant.

The water of these springs is no doubt well fitted in every way for the culture of the various species of fish that are suited to the streams of Texas.

Just below the dam on the right bank of the stream, and right at the edge of the town, is a tract of land of some 25 acres, which lies exceedingly well for the purposes contemplated. Water can be carried in pipes from the dam to any part of the tract. The slope is sufficient for the easy construction of the ponds.

San Marcos is centrally located and has satisfactory railroad facilities.

Not far below the town the San Marcos River receives the Rio Blanco from the east. This stream is quite deep in places, and much like the San Marcos in general features.

Colorado River.—This is a large stream rising in the north central part of the State and flowing southeast to Matagorda Bay. We made investigations along this river in the vicinity of Austin. Just above the city and on the right side of the river is a large spring, known as Barton Spring. Barton Creek, which is formed by this and a

number of smaller springs, is quite a good-sized stream. It has been dammed and furnishes an abundance of power for a flouring mill.

When the Texas State Fish Commission was in existence the station and ponds were located on the bank of this creek. The water was gotten upon the grounds by means of a small turbine wheel at the dam. This land could no doubt be had now for hatchery purposes and would seem to be very suitable ground, unless, indeed, the acreage be insufficient.

In a report by Jos. P. Frizell, on the proposed dam and waterworks for the city of Austin, it is stated:

The Colorado, above Austin, flows in a deep cut or cañon worn in the limestone rock. It is skirted by limestone bluffs rising often to the height of 150 feet above the bed of the river, broken by the erosion of tributary streams. No extensive meadows or bottom lands exist. The river, in its normal condition, occupies but a small part of the channel in the rock, the remainder being occupied by alluvial deposits to the depth of average high water. In great floods the river spreads from bluff to bluff.

At this point, about 2 miles above Austin, the city has begun the construction of an immense dam for the purpose of furnishing water to the city and power to many manufactories and other industries requiring it.

Mr. Frizell further says:

The channel in the rock is at this point about 1,150 feet wide at a height of 60 feet above the summer level of the river. The cross section of the channel is not far from level on the bottom, and is bounded by nearly perpendicular walls of rock rising to the height of a little over 60 feet on the city side of the river, and 125 or more on the other side. The river bed proper occupies not more than one-half of this width, the remainder of this being alluvial deposit, rising to the height of 40 or 50 feet above the river bed. The situation here is admirably well suited to the development of water power by a dam about 60 feet in height, the perpendicular face of rock rising to about that height, and thence receding from the river in a gentle slope, forming a bench on which the canal or feeder could be constructed, the alluvial strip of ground between the canal and river furnishing sites for pumping and power stations, and any other establishments requiring power.

The Colorado, at Austin, drains some 40,000 square miles, and, of course, carries, at times, an enormous flow of water. The highest flood, within the memory of the people now living, was some 45 feet above low water, and from the best data I can obtain the flow of the stream was some 250,000 cubic feet per second.

This dam is now well under way, and will be completed within a year or two.

About 2,000 feet below the dam, on the left bank of the river, is a tract of land very suitable for a station. Still farther down, less than three-eighths of a mile, is another equally good tract. The top of the dam will be at least 10 feet above the highest part of either of these tracts. All this land slopes gently toward the river and lies beautifully for the laying out of ponds. Ordinarily water taken from the dam would prove suitable, but at times when the river is roily, water could be gotten from the large reservoir to be constructed on the high hills above the dam. The city would doubtless make satisfactory arrangements and guarantees as to water rights.

If land can be had on reasonable terms, the location would prove very desirable.

NOTES ON TEXAN FISHES, WITH DESCRIPTIONS OF NEW SPECIES.

The brief time allowed for the preparation of the first part of this report was not sufficient for a critical study of all the material collected. Only the species of Cyprinoids and Cyprinodonts have been thus far carefully studied, and it has seemed best to publish in this connection the results of the study of only those two families, reserving for another paper the report upon the other fishes collected. In that paper will also be given illustrations of the other new species here described.

1. *Campostoma anomalum* (Raf.).

One specimen, 4 inches long, from the San Marcos River near San Marcos. Head, $4\frac{3}{4}$; depth, $5\frac{1}{8}$; eye, 4; D. 9; A. 7; scales, 8-54-7. Compared with specimens from the Yellow River, at Plymouth, Indiana, the Texas specimen has the scales smaller (7-46-5 in the Yellow River specimens), the lateral line less decurved, interrupted on about 10 scales of the caudal peduncle, reappearing upon the last 4 or 5 scales.

The types of *C. formosulum* Girard came from San Antonio, and have the scales about the same as the Indiana specimens.

2. *Dionda episcopa* Girard.

One specimen $2\frac{3}{4}$ inches, and one $1\frac{1}{2}$ inches long, from the Comal Spring, New Braunfels. Head, $4\frac{1}{2}$; depth, $4\frac{1}{3}$; eye, 3; D. I, 8; A. I, 8; scales, 7-40-4; teeth, 4-4; grinding surface well developed; intestine long; peritoneum black.

Body rather slender, head moderate; origin of dorsal over ventrals, a little nearer tip of snout than base of caudal, its base two-thirds its height or one-half length of head.

Color in alcohol, dark olive above, covered with numerous fine, dark specks; side, with a broad plumbeous band, running from tip of snout through middle of eye to base of caudal, where it ends in a black blotch, this band for the most part lying just above the lateral line; lower jaw, suborbital, lower opercular region, and body below lateral line, pale but with a few scattered dark punctulations.

In his "Researches upon the Cyprinoid Fishes Inhabiting the Fresh Waters of the United States West of the Mississippi Valley,"* Girard establishes the genus *Dionda* and described as new ten species belonging in it (*Dionda episcopa*, *serena*, *texensis*, *papalis*, *argentosa*, *chrysitis*, *plumbea*, *melanops*, *couchi*, and *spadicea*). The first seven of these species were described from Texas waters, the next two from Mexico, while the last one named was from Fort Smith, Arkansas. In 1885 all the types of these species that could be found either in the U. S. National Museum or in the Philadelphia Academy were studied by Dr. Jordan, who gave † the following identifications:

Girard's species.	Jordan's identifications.
<i>Dionda episcopa</i>	<i>Dionda episcopa</i> Grd.
<i>Dionda texensis</i>	Do.
<i>Dionda argentosa</i>	Do.
<i>Dionda serena</i>	<i>Dionda serena</i> Grd.
<i>Dionda papalis</i> †	? <i>Dionda serena</i> Grd.
<i>Dionda chrysitis</i>	<i>Dionda serena</i> Grd.
<i>Dionda melanops</i>	<i>Dionda melanops</i> Grd.
<i>Dionda couchi</i>	? <i>Dionda melanops</i> Grd.
<i>Dionda plumbea</i> †	? <i>Zophendum</i> ? <i>plumbeum</i> Grd.
<i>Dionda spadicea</i> †	? <i>Zophendum</i> ? <i>plumbeum</i> Grd.

† The types of those indicated by a (?) can not be found and are probably lost.

* Proc. Acad. Nat. Sci. Phila. 1856.

† Proc. U. S. Nat. Mus. 1885, 121.

Girard's types of *Dionda episcopa* consist of two specimens, each about $3\frac{1}{4}$ inches long, collected in the Pecos River by Capt. J. Pope, and bear the U. S. N. M. No. 45. They are still in fair condition and resemble very closely my specimens from the Comal Spring; in the types, however, the head is a trifle longer, the depth some greater, the dorsal appears to be a little farther forward, and the eye is not quite so large.

The types of *D. texensis* bear the U. S. N. M. No. 44, and consist of two specimens, 2 and $2\frac{3}{4}$ inches long, respectively, from the Nueces River; they can not be distinguished from *D. episcopa*.

The type of *D. argentosa* is a single specimen, $2\frac{3}{4}$ inches long, No. 32 U. S. N. M., from San Felipe Creek. This specimen is in poor condition; it does not seem to be identical with *D. episcopa*, but is a heavier, stouter species; head, $3\frac{1}{5}$; depth, $3\frac{3}{4}$; eye, $3\frac{2}{3}$; dorsal less anterior.

3. *Hybognathus nuchalis* Ag.

This species was found to be very abundant in certain places. The collection contains 143 specimens from the Neches River, east of Palestine; 43 from the Trinity, at Magnolia Point; and 10 from Big White Oak Bayou, at Houston.

Many of the Neches River specimens have the lower jaw covered with small cystic tumors, caused by the presence of psorosperms of some species of *Myxosporidia*, appearing as small whitish elevations. Some of these specimens were found to be infested about the intestines with a trematode of some species. These parasites are now being studied by Dr. R. R. Gurley, of the U. S. Fish Commission, who expects to be able to report upon them at no distant date.

4. *Cliola vigilax* (B. and G.).

This is one of the most widely distributed species of the family of minnows; we found it in abundance at each of the following places: Neches River, 14 miles east of Palestine; Trinity River, at Magnolia Point; Long Lake near Magnolia Point, Hunter Creek, Big White Oak Bayou, and Buffalo Bayou near Houston; San Marcos River, San Marcos; and Guadalupe River, near New Braunfels.

These specimens do not differ apparently from more northern specimens. The individuals from the vicinity of Houston are unusually large.

5. *Notropis cayuga atrocaudalis*, var. nov.

Head, $4\frac{2}{5}$; depth, $4\frac{2}{5}$; eye, $3\frac{1}{5}$, a little greater than snout; D. I, 8; A. I, 7; scales, 7-36-4, about 13 before dorsal; teeth, 4-4, strongly hooked, grinding surface developed.

Body moderately elongate, not much compressed, back little elevated; head short and bluntly conic, snout shorter than eye; caudal peduncle short and deep; origin of dorsal slightly behind ventrals, nearer caudal peduncle than snout; anal small, its longest rays shorter than head; lateral line complete.

Color in alcohol: Above olivaceous, profusely covered with fine brownish punctulations, thickest around border of scales, not crosshatched; side with a black band half width of eye, following direction of lateral line and ending in a black spot at base of caudal; this band also extends across cheek through eye and around snout; top of head dark, snout above the black band pale; lower half of head pale, opercles silvery.

The 17 specimens upon which this description is based were obtained in the Neches River, east of Palestine, Texas, November 24, 1891. They very closely resemble *N. cayuga* Meek, but I hesitate to identify them with that species on account of the somewhat longer snout and the complete lateral line.

6. *Notropis deliciosus* (Girard).*Moniana deliciosa* Girard, Proc. Acad. Nat. Sci. Phila. 1856.

This appears to be an abundant species in southern Texas, as indicated by the specimens in the collection, viz:

Kilper's Pond, Houston	1
Big White Oak Bayou, Houston	2
Buffalo Bayou, Houston.....	9
Hunter Creek, Houston.....	31
Rio San Marcos, San Marcos.....	26
Guadalupe River, New Braunfels.....	82
San Antonio River, San Antonio.....	76

Numerous specimens examined give the following measurements: Head, $4\frac{1}{2}$ to $4\frac{2}{3}$; depth, $4\frac{1}{3}$ to $4\frac{2}{3}$; eye, 3; D. I, 8 or 9; A. I, 8; scales, 6-36 or 37-3, 13 or 14 before the dorsal.

Body slender, head moderate; snout rather blunt, less than eye or interorbital width; the mouth not large, subinferior, oblique, lower jaw included; origin of dorsal slightly behind base of ventrals, midway between tip of snout and base of caudal fin, high, the longest rays, which are the anterior ones, nearly as long as head; anal base short, its longest rays $1\frac{2}{3}$ in head.

Color in alcohol: Scales above lateral line with numerous fine black specks, thickest along border of each scale, forming cross-hatching, darkest along middle line of back, a black blotch on back in front of dorsal and another on caudal peduncle at beginning of caudal fin; base of dorsal fin dusky; top of head and upper jaw dark; a few dark specks on upper part of opercle, the lower portion and the lower jaw pale; side with a broad plumbeous band, about one scale wide, lying along lateral line, this dusted over with fine, darker punctulations. This color description applies more especially to the San Antonio specimens. Those from the other places, especially those from about Houston, are much paler, but the general pattern of coloration is the same. Many of the females of the San Antonio lot contained well-developed eggs.

7. *Notropis nux*, sp. nov.

This species is based upon specimens from the following places:

Neches River, Palestine	10
Trinity River, Palestine	1
Long Lake, Palestine.....	1

Head, 4 to $4\frac{1}{2}$; depth, $4\frac{1}{2}$; eye, 3 to $3\frac{1}{2}$; D. I, 8; A. I, 7 or 8; scales, 6-37 or 38-3 or 4, 13 or 14 before the dorsal; teeth, 1, 4-4, 2 in the Long Lake specimen, apparently only 1, 4-4, 0 or 1 in the others; grinding surface developed and somewhat crenate, especially in the Neches River specimens.

Body rather slender, somewhat elevated, head subconic, snout rather blunt, a little decurved; mouth moderate, oblique, maxillary not reaching orbit, lower jaw slightly included; eye rather large, about 3 in head, equal to snout, also to interorbital width; caudal peduncle long and slender, its least depth $2\frac{1}{2}$ in head. Origin of dorsal fin over insertion of ventrals, nearer snout than base of caudal, height of fin equals length of head, base short; anal smaller; pectorals short, not reaching ventrals, which, in turn, do not reach the anal; caudal long and widely forked; lateral line complete, nearly straight; peritoneum pale, with a few brown spots.

Color in spirits: Greenish above, covered with numerous fine, brownish punctulations, thickest along edges of scales, forming cross-hatching extending about one-fifth way down the side; trace of a dark vertebral line; side with a somewhat distinct plumbeous band, heaviest on caudal peduncle and ending in most specimens in a small but distinct caudal blotch; this band also extends across opercles, through the eye and upon the snout; between this band and the cross-hatching of the back is a pale yellowish area, about one scale wide with a few scattered specks showing under the lens; body below lateral line pale, with few specks except about base of anal fin and along under side of caudal peduncle where they are numerous; fins with few very fine dark points.

Etymology: Latin, *nut*, nut; in allusion to the Neches River, as Neches is said to mean *nut*.

8. *Notropis nocomis*, sp. nov.

Head, $4\frac{1}{4}$ to $4\frac{1}{2}$; depth, $4\frac{3}{4}$ to 5; eye, 3 to $3\frac{1}{4}$; D. I, 8 or 9; A. I, 8; scales, 6-36-3; teeth, 1, 4-4, 1, small, hooked, the grinding surface narrow, apparently a little crenate; peritoneum silvery, with a few small dark specks.

Body rather slender, but little elevated; head heavy, resembling that of *Otiola vigilax*; snout blunt and rounded, about equal to eye; mouth small, inferior, horizontal, lower jaw included and overhung by the rounded snout; maxillary short, not nearly reaching orbit; eye large, equal to interorbital width; preorbital broad; caudal peduncle long and slender, its least depth less than half length of head. Dorsal inserted directly over the ventrals, high, the longest rays 4 times in length of body, one-fifth longer than head, or twice length of fin, reaching middle of anal when depressed, the free margin nearly straight; anal resembling dorsal in shape, but smaller, its longest rays as long as head; pectorals short, not reaching ventrals; ventrals scarcely reaching anal fin; lateral line complete, nearly straight.

Color in alcohol: Yellowish, upper parts of body with numerous fine brown punctulations, chiefly margining the scales so as to form cross-hatching; lower parts plain yellowish; a dark lateral band, faint on the anterior half of side, plainest on caudal peduncle; no caudal spot; fins, under the lens, show a few fine specks; top of head dark, snout pale.

This species is described from about 130 specimens, each about $2\frac{1}{2}$ inches in total length, taken in the Trinity River at Magnolia Point, near Palestine, Texas, and five examples from the San Marcos River at San Marcos, Texas. These specimens are indistinguishable by me from specimens collected at New Braunfels, Texas, in 1884, by Drs. Jordan and Gilbert, and referred to in Jordan's Catalogue of 1885 under the manuscript name *Notropis nocomis*. In the paper on their Texas collection, these authors concluded that their specimens were identifiable with Girard's *Moniana deliciosa*, and consequently gave no description. I obtained numerous specimens at San Marcos, New Braunfels, and elsewhere, of what agrees well with the types of *Moniana deliciosa* Grd., with which I have compared them, but they are quite a different fish from that for which I adopt the name *nocomis*. In *Notropis nocomis* the head is heavier and broader, the snout is much more blunt, the mouth smaller and more nearly horizontal, and the lower jaw is shorter and included. I have, therefore, thought best to describe this form as a new species, adopting for it the manuscript name of Jordan and Gilbert.

In the Trinity River, at Magnolia Point, this species was found in great numbers on a ripple when the current was pretty strong.

One specimen, 2½ inches long, from Buffalo Bayou, I refer to this species for the present, though it presents some differences. The body is a little more slender, the mouth some larger and less inferior, and the color is darker; the dark lateral band is well developed and extends across the opercles and around the snout. These color differences, however, might well be due to the quite different characters of the streams from which the specimens came.

The specimen from Buffalo Bayou measures as follows: Head, 4¼; depth, 5¼; eye, 3, greater than snout; D. I, 8; A. I, 8; scales, 6-38-3; teeth, 1, 4-4, 1. Height of dorsal fin greater than length of head.

9. *Notropis lutrensis* (B. and G.).

Neches River east of Palestine.....	1
Trinity River, Magnolia Point, near Palestine.....	180
San Marcos River, San Marcos.....	537
Guadalupe River, New Braunfels.....	40
San Antonio River, San Antonio.....	4

This species is, as shown above, exceedingly abundant in the Trinity and San Marcos rivers, and is quite common at each of the other localities where specimens were found by us. This is one of the most variable and most widely distributed of the Southwestern Cyprinoids.

10. *Notropis venustus* (Girard).

- Cyprinella venusta* Girard, Proc. Acad. Nat. Sci. Phila. 1856, 198, and Mex. Bd. Survey, 54, Pl. xxxi, Figs. 1-4, 1859 (Rio Sabinal, Texas, collected by Dr. C. B. Kennerly).
Notropis venustus Jordan and Gilbert, Proc. U. S. N. M. 1886, 14 (Red River, Fulton, Ark.); 19 (Lampasas River, Belton, Tex.); 20 (Colorado River, Austin, Tex.).

This, one of the most attractive of Cyprinoids, is an abundant species in many of the streams examined by us. The following specimens are in the collection:

Neches River, east of Palestine, Texas.....	3
Trinity River, Magnolia Point, Texas.....	2
Buffalo Bayou, Houston, Texas.....	12
Big White Bayou, Houston, Texas.....	19
Hunter Creek, Houston, Texas.....	73

The specimens from about Houston are very fine and large, some of them being as much as 4 inches long. The black caudal spot is larger and not so far back upon the caudal fin as shown in Girard's figure.

11. *Notropis swaini* Jordan and Gilbert.

- Alburnus megalops* Girard, Proc. Acad. Nat. Sci. Phila. 1856, 193 (San Felipe Creek, Texas).
Alburnellus megalops Girard, Mex. Bd. Survey, 52, Pl. xxxix, figs. 1-4, 1859 (San Felipe Creek, Texas). (Name preoccupied in this genus.)

This species is abundant in Texas, and specimens were obtained by us at the following places:

San Marcos River, San Marcos, Texas.....	21
Comal Creek, New Braunfels, Texas.....	36

Drs. Jordan and Gilbert obtained this species in Comal Creek, San Marcos River, and the Colorado River at Austin.

Head, 4 to $4\frac{1}{2}$; depth, 4 to $4\frac{3}{8}$; eye, $2\frac{1}{2}$ to 3, greater than snout; D. I, 8; A. I, 8 or 9; scales, 7-38-3, about 14 before the dorsal; teeth, 1, 4-4, 1 or 2, somewhat hooked and with evident grinding surface.

Body moderately elongate, compressed, back little elevated; head rather heavy, snout short and obtuse, mouth large, oblique, lower jaw slightly projecting, maxillary extending to below level of pupil; eye quite large, greater than width of interorbital space or length of snout; caudal peduncle moderate, its least depth equal to distance from tip of snout to middle of eye; fins not large, dorsal inserted behind the ventrals; origin of anal behind last rays of dorsal; lateral line continuous, slightly decurved.

Color: Upper third of body pale yellowish, with numerous small brown specks arranged chiefly parallel with the borders of the scales, not presenting a true cross-hatched appearance; top of head dark, snout, region about the nostrils, and supra-ocular region paler; a dark dorsal line from nuchal region to caudal fin; lower two-thirds of body silvery, the upper part being more or less plumbeous forming a broad band well defined above, but less so below; lower third of caudal and forward to tips of ventrals plain yellowish; opercles and cheeks very silvery; breast and lower jaw pale.

12. *Notropis dilectus* (Girard).

Alburnus dilectus Girard, Proc. Acad. Nat. Sci. Phila. 1856, 193 (Arkansas River, near Fort Smith).

Four specimens of what I for the present refer to this species were obtained from Long Lake, near Palestine; one from Neches River, east of Palestine; and several hundred specimens, the largest about $2\frac{3}{4}$ inches long, from the Trinity River at Magnolia Point. Drs. Jordan and Gilbert obtained specimens of what they referred to Girard's *dilectus* from the Sabine River, Long View, Texas; Saline River, Belton, Arkansas, and from the Arkansas River near Fort Smith.

Girard's original description of the species is as follows:

1. *Alburnus dilectus*, is about three inches and a half in total length; the head forming a little less than the sixth part of it. The greatest depth is nearly equal to the length of the head. The diameter of the circular eye is contained a little more than three times in the length of the side of the head, and less than once in advance of its anterior rim. There are ten longitudinal rows of scales between the insertion of the ventrals and the base of the dorsal. The lateral line is upon the fourth row from the ventrals upwards. The color is uniform yellowish red with a lateral silvery streak.

The types of this species consist of two specimens, 3 and $3\frac{2}{5}$ inches long respectively, and are numbered 71, in the U. S. National Museum catalogue. They are in very good condition, and present the following measurements: Head, $4\frac{1}{2}$ ($5\frac{1}{2}$) and $4\frac{1}{4}$ ($5\frac{1}{4}$); depth nearly equal to length of head; eye, $3\frac{1}{2}$ in head in each, longer than snout.

The specimens obtained by us may be described as follows: Head, 4 to $4\frac{1}{2}$ (5 to $5\frac{1}{2}$); depth, $4\frac{3}{4}$ to 5 (6 to $6\frac{1}{4}$); eye, 3 to $3\frac{1}{2}$; scales, 7-38-3.

Body slender, compressed, scarcely elevated; head narrow; eye large, greater than snout, equal to width of interorbital space; mouth rather large, quite oblique, maxillary reaching orbit.

Dorsal much nearer base of caudal than snout, considerably behind ventrals, high, its anterior rays longest, free margin straight; anal larger than dorsal, free margin concave; caudal deeply forked; pectorals short, not reaching ventrals, which are also short, not reaching anal. Lateral line somewhat decurved. Peritoneum silvery, with numerous dark-brown specks. Color, very pale yellowish, side with plumbeous band very indistinct on anterior third of side, plainest on caudal peduncle; back and sides down to lateral line covered sparsely with small dark specks arranged mostly along

border of scales, largest just above lateral line; top of head dark, snout pale, lips dark-edged; a row of somewhat larger specks along median line of back from occiput to caudal fin; body below lateral line plain yellowish without any specks except a single row at base of anal fin on each side, usually quite distinct in most specimens; entire side of head silvery; fins, especially dorsal and anal, with a few small dark points. The specimens from Long Lake are a little more heavily spotted than those from the river.

13. *Notropis fumeus*, sp. nov.

Allied to *Notropis dilectus* (Grd.). Head, $4\frac{1}{2}$ to $4\frac{2}{3}$; depth, $4\frac{2}{3}$ to 5; eye, 3 to $3\frac{1}{3}$; D. I, 8; A. I, 11; scales, 7-40-3; teeth, 2, 4-3 (?) 2, hooked.

Body slender, greatly compressed, dorsal and ventral outline gently arched; head moderate, conic; snout pointed, shorter than eye; eye large, equal to interorbital width; mouth rather large, oblique, lower jaw projecting, scarcely included, maxillary scarcely reaching orbit; caudal peduncle long, compressed, its least depth equal to distance from tip of snout to middle of pupil; lateral line complete, considerably deurved. Origin of dorsal behind ventrals, nearer base of caudal than tip of snout, its height less than length of head; anal larger, its base $1\frac{1}{3}$ in head; pectorals short, not reaching ventrals; ventrals short, just reaching vent. Peritoneum pale silvery, with some small dark specks.

Color: Dark yellowish above, thickly covered with small dark-brown specks; the majority of these are very small, but interspersed among them are a good many of larger size, spots most numerous in certain lines forming distinct cross-hatching; a dark line along middle of back; side with a broad, dark plumbeous band, overlaid with numerous rather large brown spots, thickest and darkest toward caudal peduncle; this band also extends across opercle and around the snout; lower jaw with anterior half darkened by numerous specks; lower parts, pale silvery, with few or no specks except at base of anal fin, which has a rather heavy row on each side, in some specimens continuing along under side of caudal peduncle to caudal fin; dorsal, anal, and caudal with some black on membranes, pectorals edged with black.

This species is based upon 4 specimens, each a trifle over 2 inches in length, taken in Hunter Creek, about 9 miles from Houston, Texas, November 20, 1891. It very closely resembles *N. dilectus* (Grd.), and may prove to be not specifically distinct from that species; the lateral line is, however, more deurved, the scales seem to be some smaller and the color is markedly different in the distinctness of the broad plumbeous lateral band.

14. *Notropis notemigonoides*, sp. nov.

Head, 4 to $4\frac{1}{2}$; depth, $4\frac{1}{4}$ to $4\frac{1}{2}$; eye, $3\frac{1}{4}$ to $3\frac{1}{2}$; D. I, 8; A. I, 10 or 11; scales, 10-41-3, about 29 before the dorsal; teeth, 2, 4-4, 2, hooked, grinding surface moderately broad, plainly crenate.

Body slender, greatly compressed, somewhat elevated; head conic, snout pointed, about equal to eye; mouth large, oblique, lower jaw slightly projecting, maxillary reaching orbit; eye rather large, equal to snout, but a little less than interorbital width; caudal peduncle long and compressed, its least width only half diameter of orbit. Fins moderate, dorsal inserted behind ventrals a distance equal to diameter of eye, much nearer base of caudal fin than snout, its rays about as long as head, free margin straight; anal with longer base but shorter rays; pectorals falcate, not reach-

ing ventrals; ventrals short, scarcely reaching anal; caudal long and deeply forked. Scales rather small and closely imbricated, very small and crowded before the dorsal; lateral line complete, greatly decurved, as in *Notemigonus*.

Color in spirits: Pale yellowish above, silvery below; upper half of body sprinkled over with numerous small, dark-colored spots, thick enough along median line of back to form a narrow dark vertebral band from occiput to base of caudal fin; the spots on anterior part of side so arranged as to form about sixteen obtuse angles fitting into each other, the angles opening forward, thus >>, these markings being upon alternate scales; a silvery band on caudal peduncle overlaid with fine dark specks; top of head dark, snout pale, but with many fine punctulations; tip of lower jaw with some small specks; sides of head silvery; all the fins except the pectorals with many fine dark points, most numerous on dorsal and caudal. This curious species of *Notropis* bears a very close superficial resemblance to *Notemigonus chrysoleucus*, but of course its generic relationship is with the *Notropes*.

This species is based upon the following specimens: Three specimens, 2 to 2½ inches long, from Neches River, 14 miles east of Palestine, Texas, November 24, 1891, and 3 specimens of about the same size, from Sims Bayou, near Houston, Texas, November 18, 1891. The specimens from Sims Bayou, like all other fishes from that place, are very much bleached, but show the same general pattern of coloration as those from the Neches River.

15. *Phenacobius mirabilis* (Girard).

Exoglossum mirabile Girard, Proc. Acad. Nat. Sci. Phila. 1856, 191 (Arkansas River, Fort Smith).

Two specimens from the Trinity River at Magnolia Point, near Palestine. Also taken by Drs. Jordan and Gilbert in the Sabine River at Longview, Texas, and the Arkansas River near Fort Smith.

16. *Hybopsis æstivalis marconis* J. and G. (Pl. xxxv.)

Hybopsis æstivalis marconis Jordan and Gilbert, Proc. U. S. N. M. 1886, 22 (San Marcos River).

Head, 4½; depth, 5½; eye, 3½, less than snout, but equal to interorbital width.

We found this fish very abundant in the San Marcos River below San Marcos, and in the Guadalupe River near New Braunfels. It seems to be like *Hybopsis hyostomus*, a fish of the rapid, open stream, as we found it only where the water was pure and clear and the current very swift. At a single haul with a 12-foot seine in the Guadalupe River, between the two bridges near New Braunfels, several hundred fine specimens were taken.

17. *Opsopœodus osculus*, sp. nov.

I refer to this species specimens from the following places:

Neches River east of Palestine, Texas, November 24, 1891	20
Long Lake, Palestine, Texas, November 25, 1891	2
Buffalo Bayou, Houston, Texas, November 16, 1891	4
Kilper's Ponds, Houston, Texas, November 21, 1891.....	4
Sims Bayou, Houston, Texas, November 18, 1891.....	48
Dickinson Bayou, Nicholstone, Texas, November 14, 1891	4

Head, 4½ to 4¾; depth, 4½ to 5; eye, 3; D. I, 10; A. I, 8; scales, 6 or 7-38 to 41-3 or 4; teeth, 4-4 or 4-5, more or less serrate and hooked, the pharyngeals small and weak; peritoneum silvery, with small brown specks.

Body rather slender, little elevated, head subconic, its depth at eye but half its length, snout blunt, shorter than eye; mouth very small, almost vertical, scarcely any

lateral cleft; scales moderate, rather deeper than long, those in front of dorsal small; breast naked; lateral line complete, somewhat decurved. Origin of dorsal slightly behind that of ventrals, nearer snout than base of caudal, its height equal to length of head, pointed, the free margin nearly straight, inclined to be concave; anal small, its base one-half length of head, about equal to the dorsal in height.

Color of Neches River specimens pale, the upper parts of the body with numerous fine brown specks arranged chiefly along edge of scales so as to give a regular cross-hatching, this covering the caudal peduncle; middle of side with a plumbeous band about one scale wide, extending also across cheek and upon snout; two rows of small spots above and parallel with the plumbeous band and one below it, not distinct in some specimens; top of head dark, an indistinct line from nape to origin of dorsal fin; lower parts of body plain except on posterior portion where the cross-hatching extends to under side of caudal peduncle; no spot at base of caudal; fins plain or with a few scattered punctulations on dorsal and anal, no evidence of the large black area found on dorsal fin of *O. emiliae*.

The specimens from Long Lake, Dickinson Bayou, Buffalo Bayou, and Kilper's Ponds agree in color with those from the Neches River, while all the specimens from Sims Bayou are nearly uniform pale yellowish throughout, there being no markings anywhere except a very faint lateral band and a few scattered punctulations discernible only under a lens; dorsal and anal wholly plain. The pale, bleached appearance of the specimens from Sims Bayou is quite certainly due to the peculiar character of the place in which they were found, it being a shallow, isolated, and stagnant pool with mud bottom, containing scarcely any vegetation and lying exposed on the open prairie. Thousands of cattle from the surrounding prairie come to this pool for water during the dry season, and, in consequence, the banks are much cut up and the water is more or less foul. These conditions, of course, have their effect upon the fishes found there, and all the species obtained there by us present the same faded appearance.

This species is quite close to *O. emiliae* Hay, but may be distinguished from it by the less depth of the head, the more pointed dorsal and anal fins, and by the very different coloration. A specimen of *O. emiliae* from Mayfield Creek, Kentucky, collected by Mr. A. J. Woolman, has the depth at the eye half length of head, and the free margin of the dorsal, as well as that of the anal, is convex, while in the Texas specimens it is straight or even concave, due to the greater length of the first three rays. These small differences, together with the entire absence of the large black spot on the dorsal fin which constitutes such a noticeable feature in the coloration of *O. emiliae*, and the presence (except in the bleached specimens) of a much more distinct plumbeous lateral band than is found in any of the specimens of *O. emiliae* that I have examined, do not permit me to believe that the two are specifically identical. To regard the Texas specimens as being *O. emiliae* would require, it seems to me, either that the lateral band should be obsolete or that there should be some evidence of the presence of the black area on the dorsal fin; for it would seem that conditions which would result in *intensifying* one of these color markings would not *obliterate* the other.

This species differs from the other of the two known species of this genus (*O. bollmani*, recently described by Dr. Charles H. Gilbert, from Buckhead Creek, Georgia), in having the lateral line complete and in not having the black caudal spot so conspicuous in that species.

18. *Notemigonus chrysoleucus* (Mitch.).

Numerous specimens of this widely distributed minnow were taken at each of the following places: Neches River, 14 miles east of Palestine; Long Lake and Trinity River, near Palestine; Sims Bayou, Kilper's Ponds, and Big White Oak Bayou, at Houston; and Dickinson Bayou, near Dickinson.

19. *Cyprinodon variegatus* (Lacépède).

Thirty specimens of this species were obtained at Galveston, 3 from Dickinson Bayou, and 10 from Corpus Christi. It is abundant both at Galveston and Corpus Christi. This is the form described by Baird and Girard as *C. gibbosus*, but our specimens do not seem to differ materially from northern ones.

In our study of this and related species we had occasion to compare specimens of *Cyprinodon carpio* Günther and *C. mydrus* Goode & Bean, and can not see any tangible differences.

20. *Fundulus similis* (B. & G.).

The collection contains 14 specimens from Galveston and 2 from Corpus Christi. It is an abundant species at each place.

21. *Fundulus heteroclitus* (L.).

A dozen specimens from Corpus Christi, 2 from Dickinson Bayou, and 14 from Galveston, at each of which places it is abundant.

22. *Fundulus pallidus*, sp. nov. (Pl. xxxv.)

One specimen, $1\frac{3}{4}$ inches in total length, taken in Galveston Bay, near Swan Lake, Texas, November 10, 1891. Head, $3\frac{1}{2}$; depth, 4; eye, $3\frac{1}{2}$; D. 12; A. 11; scales, 31-11, about 16 before the dorsal.

Body, stout; head, heavy; caudal peduncle long and much compressed; snout, short and blunt, shorter than eye, which is two-thirds the width of the interorbital space; humeral scale not enlarged, two rows of scales on the cheek; mouth rather small, little oblique, teeth pointed, in more than one series, the outer enlarged. Dorsal fin over the anal, its origin midway between base of caudal and posterior edge of opercle, or midway of total length, its ray short, about $1\frac{1}{2}$ in head; anal rays about equal in length to those of dorsal.

Scales medium, not firmly attached, 31 in longitudinal series, 11 in transverse from dorsal to anal, about 16 before the dorsal.

Color, pale yellowish; sides with about 13 narrow, dark, vertical bars, much narrower than the pale interspaces, not extending on the back or belly; scales sparsely covered with fine dark punctulations, few on the vertical fins and head; a large oblong black spot on the back immediately in front of dorsal fin.

This species is allied to *Fundulus similis* Baird and Girard, but the head is less pointed, the snout very much shorter, it being shorter than the eye, while in *F. similis* it is $1\frac{1}{2}$ times the eye, the dorsal has one more ray and the anal two or three more, the color is paler, the bars less distinct, there is no dark dorsal line as in the other, while the pronounced black spot in front of the dorsal is not found on *F. similis*.

23. *Fundulus xenicus* Jordan and Gilbert.

Fundulus xenicus Jordan and Gilbert, Proc. U. S. N. M. 1882, 255 (Pensacola); Synopsis, 1882. 892.
Adinia multifasciata Girard, Proc. Acad. Nat. Sci. Phila. 1859, 117.

Four specimens of this interesting little species were taken in Galveston Bay. Head, 3; depth, $2\frac{1}{2}$; eye, 3; snout, 3; D. 12; A. 12.

Body greatly compressed, the back elevated, profile from snout to dorsal nearly straight, this forming an acute angle with the ventral line from snout to anal fin; caudal peduncle very deep, its greatest depth $1\frac{1}{4}$ in head; dorsal large, its origin in front of anal, the longest rays nearly as long as head. The dusky blotch said to be below and behind the eye is not evident.

24. *Zygonectes funduloides*, sp. nov. (Pl. xxxv.)

This species is described from two specimens, each $1\frac{1}{2}$ inches long, from Dickinson Bayou, Dickinson, Texas, November 13, 1891. Head, $3\frac{1}{4}$; depth, $4\frac{1}{2}$; eye, $3\frac{1}{2}$; D. 9 or 10; A. 9; scales, 35-11, 24 before the dorsal.

Body moderately robust, width at pectorals a little greater than greatest depth of head; snout rather blunt, equal to eye; interorbital width $1\frac{3}{8}$ times diameter of eye; caudal peduncle deep and compressed; mouth not large nor greatly oblique; teeth pointed, the outer series being somewhat enlarged; peritoneum pale. General color in spirits, dark olivaceous, sides with 10 to 14 dark vertical bars which are usually two to three times as wide as the intervening silvery ones; in one specimen the bars extending from the dorsal to the anal are about equal in width to the silvery interspaces; whole body, including all the fins, profusely dusted over with minute brownish spots which are very numerous on back and top of head; a narrow, dark line extending from nape to origin of dorsal.

Dorsal fin small, slightly in front of anal, its origin midway between posterior edge of opercle and base of caudal fin, the longest rays about equal to base of fin, or half length of head.

If the characters which are used to distinguish the genus *Fundulus* from *Zygonectes* are really of generic value, the small size of the dorsal fin would put this species in *Zygonectes*, though the position of the fin is rather that of *Fundulus*. I have compared these specimens with numerous young individuals of *F. heteroclitus* collected by Dr. H. M. Smith at St. George Island, Maryland, and find them very similar in general appearance; in *Z. funduloides*, however, the dorsal is placed further back, and has fewer rays (9 or 10 instead of 12), the anal is smaller (9 instead of 11); the pattern or coloration is the same, but the contrasts are more marked, and instead of the dark dorsal band found in this species the young of *F. heteroclitus* have a small dusky area at base of dorsal in front; the young have an ocellus upon last rays of dorsal, which is not found in the other species.

25. *Zygonectes pulvereus*, sp. nov. (Pl. xxxvi.)

This species is based upon the following specimens:

Nine specimens, $1\frac{3}{8}$ to 2 inches long, from Dickinson Bayou, Dickinson, Texas, November 13 and 14, 1891.

One specimen, $1\frac{1}{2}$ inches long, from Buffalo Bayou, Houston, Texas, November 16, 1891.

One specimen, $1\frac{1}{2}$ inches long, from the mouth of Oso Creek, Corpus Christi, Texas, November 28, 1891.

Head, $3\frac{1}{2}$; depth, $4\frac{1}{2}$; eye, $3\frac{1}{2}$; D. 10 (11 in one specimen); A. 10 (occasionally 9); scales, 35-11, about 22 before the dorsal.

Body stout, heavy forward; head broad and flat, the snout short and blunt; caudal peduncle long, deep, and greatly compressed; eye moderate, $1\frac{1}{2}$ in interorbital width, greater than snout; humeral scale not enlarged, four rows of scales on cheek; mouth rather small, but little oblique; teeth pointed, in more than one series, the outer enlarged and canine-like; peritoneum pale. Dorsal slightly in advance of anal, its origin midway between tip of caudal and anterior rim of orbit, or about midway between base of caudal and opercular opening; anal small, its longest rays $1\frac{1}{2}$ in head.

Color in alcohol, olivaceous, profusely sprinkled or dusted all over except on breast with very fine brown punctulations, so abundant on back as to obscure the individual specks; median line of back with a black stripe from occiput to dorsal fin; sides with 10 to 12 or more brown spots of larger size, these sometimes arranged somewhat definitely in two longitudinal lines, in the upper one of which the spots are confluent in some examples, forming large, oblong blotches; all the fins except the ventrals with numerous very small brown specks.

This species resembles *Z. jenkinsi*, but differs from it in the larger dorsal, much smaller anal, smaller scales, the much shorter snout, the heavier or broader head, and in the coloration. The localities from which the types were obtained would indicate that it is an inhabitant of water that is but little brackish or almost fresh.

26. *Zygonectes jenkinsi*, sp. nov. (Pl. xxxvi.)

This species is based upon 21 specimens, ranging in length from $1\frac{1}{2}$ to $2\frac{1}{8}$ inches, collected in Dickinson Bayou, near Dickinson, Texas, November 14, 1891, and 11 examples from Galveston Bay, Galveston, Texas, collected a day or two earlier.

Head, $3\frac{1}{2}$; depth, $4\frac{1}{2}$ ($4\frac{1}{6}$ to 5); eye, $3\frac{1}{2}$ ($3\frac{1}{3}$ to $3\frac{2}{3}$); D. 8 or 9; A. 12 (11 to 13); scales, 33-10, 18 before the dorsal. Body moderately elongate, head depressed, wide between the eyes, pointed, the snout about one-fourth greater than eye, which is contained $1\frac{1}{2}$ times in interorbital width; mouth rather large, little oblique; teeth in more than one series, the outer enlarged, pointed, and slightly curved inward; humeral scale small, three rows of scales on cheek. Fins medium, dorsal slightly behind anal, midway between tip of caudal and posterior rim of orbit, the distance from tip of snout to origin of dorsal being twice the distance from that point to base of caudal fin; dorsal and anal low, their longest rays half length of head; base of anal $2\frac{1}{2}$ in head; pectorals $1\frac{3}{4}$ in head; ventrals short, $1\frac{1}{2}$ in pectoral; caudal fin truncate, about as long as head; peritoneum black.

Color, pale olivaceous, covered except on breast with numerous minute dark-brown specks, arranged chiefly along the edges of the scales, thus giving the sides and back a checkered or cross-hatched appearance; in addition to these fine punctulations, there are usually 15 to 30 larger spots more or less definitely arranged in two rows lying along or above the axis of the body; in some examples these spots are absent or blended so as to form short, indistinct vertical bars; in most specimens there is a very obscure lateral band about one scale in width; fins plain or with few very minute punctulations; top of head dark.

Related to *Z. rubrifrons* Jordan, but differing from it in the following particulars: The body is more slender, the head is shorter, the dorsal and anal are larger, and the color markings are quite different. Compared with specimens of *Z. henshalli* Jordan,

it is more slender, the snout is longer and more pointed, and the color is not the same; from specimens of *Z. cingulatus* Cuv. and Val. from Pensacola, the differences are seen to be about the same as those which distinguish it from *Z. henshalli*; from the types of *Z. auroguttatus* Hay, it differs chiefly in the greater number of anal rays and the less distinct crossbars.

I name this species for Prof. Q. P. Jenkins, of Leland Stanford Junior University, in recognition of his work upon the fishes of the Sandwich Islands.

27. *Zygonectes notatus* (Raf.).

Specimens of this widely distributed species were obtained at the following places:

Neches River, east of Palestine.....	27
Trinity River, at Magnolia Point	2
Long Lake, near Magnolia Point	15
Buffalo Bayou, Houston	7
Big White Oak Bayou, Houston	23
San Antonio Springs, San Antonio	5

These Texas specimens do not differ apparently from examples collected in Indiana.

28. *Zygonectes escambiae* Bollman.

Zygonectes escambiae Bollman, Proc. U. S. N. M. 1886, 463 (Escambia River, Flomaton, Ala.).

From a pond on the bank of the Trinity River, at Magnolia Point, we obtained 5 specimens that I refer to this species.

Head, 4; depth, 5; eye, $2\frac{3}{4}$, greater than snout; scales about 38-10, 20 before the dorsal; dorsal, 7 or 8, slightly behind the anal; anal, 9. Sides with about 10 brownish or chocolate lines made up of a spot on each scale; in two of the five examples these lines are more nearly continuous than in the others; between these are smaller spots hardly forming lines; the individuals with the spots most distinct are probably males.

Compared with the types of *Z. escambiae*, these specimens are more slender, the spots come nearer to forming continuous bands, and the fins are all plain, compared with the types of *Z. craticula* Goode and Bean, which are from Indian River, Florida; the snout is shorter and less pointed, the lower jaw projects less, and the longitudinal lines are less marked. Specimens of *Z. craticula* collected at Titusville, Florida, by Mr. R. E. Earll, show about 10 dark crossbars not developed on any of the other specimens examined except on one collected at Westville, Florida, by Dr. O. P. Hay, and identified by him as the *Z. nottii* of Agassiz. *Zygonectes escambiae* Bollman closely resembles *Z. craticula* Goode and Bean, and it may be that they are both identical with *Z. nottii* Ag. The briefness of Agassiz's description of *Z. nottii* makes it very difficult to identify that species with certainty, and it is perhaps best to let the names stand as above.

29. *Lucania parva* (B. and G.).

Cyprinodon parvus Baird and Girard, 9th Smithsonian Report, for 1854, 345 (Greenport, Long Island).

One specimen of this interesting little fish was taken in Sims Bayou, at Houston, 3 in Dickinson Bayou, 4 in San Antonio Springs, and 4 at Corpus Christi.

This species at first glance much resembles *Gambusia patruelis*, and, in collecting, is apt to be mistaken for that species.

30. *Gambusia patruelis* (B. and G.).

Heterandria patruelis Baird and Girard, Proc. Acad. Nat. Sci. Phila. 1853, 390.

Gambusia gracilis Girard, Proc. Acad. Nat. Sci. Phila. 1859, 121 (Matamoras).

Gambusia humilis Günther, Cat. Fish., vi, 335, 1866 (Matamoras).

Haplochilus melanops Cope, Proc. Amer. Phil. Soc. 1870, 457 (Neuse River).

Zygonectes atrilatus Jordan and Brayton, Bull. U. S. N. M., xii, 84, 1878 (Neuse River, North Carolina.)

Zygonectes brachypterus Cope, Jordan and Gilbert's Synopsis, 341, 1882 (Trinity River and other streams of Texas).

This species is represented in the collection from Texas by the following specimens:

Neches River, east of Palestine	1
Trinity River at Magnolia Point.....	2
Long Lake, near Magnolia Point	2
Buffalo Bayou, Houston	8
Hunter Creek, Houston	10
Kilper's Ponds, Houston	38
Big White Oak Bayou, Houston	5
Sims Bayou, Houston	48
Dickinson Bayou, Dickinson.....	36
San Antonio Springs, San Antonio	15
Comal Creek, New Braunfels	127
Rio San Marcos, San Marcos.....	68

All the specimens from the first seven localities show the dark suborbital spot very distinctly. All the specimens from Sims Bayou are very pale and there is no suborbital spot in any of them, but all the fishes gotten from this place present a bleached appearance, due, no doubt, to the character of the water in which they were found, which was a muddy and foul pool left by the drying up of the greater part of the stream. Of the specimens obtained from Dickinson Bayou, 4 show the spot while the others are plain. All these specimens were also quite pale. The 15 specimens from San Antonio are quite dark, and the majority show the dark suborbital spot. The majority of the numerous specimens from New Braunfels show the spot, though in some it is quite faint and in others it is wholly absent. All these specimens are quite dark and resemble those from San Antonio. Those from San Marcos are rather pale and but few of them show the suborbital spot.

There do not seem to be any good reasons for separating *G. humilis* from *patruelis*, even as a geographical form.

In many of the female specimens from San Antonio and New Braunfels the embryos are quite large, fully $\frac{1}{4}$ inch in length, showing that the species produces its young in midwinter in southern Texas. Specimens collected by Dr. Hugh M. Smith, at St. George Island, Maryland, July 1, contained immature eggs, while others collected at the same place by him August 11 contained young apparently ready for extrusion.

31. *Mollienesia latipinna* Le Sueur.

One specimen of this attractive species was taken at Corpus Christi, 2 at Galveston, 42 at Dickinson Bayou, and 1 from Hunter Creek, near Houston.

LIST OF CRUSTACEA COLLECTED.

[By Mary J. Rathbun, Department of Marine Invertebrates, National Museum.]

The collection of Crustacea of which a list is given below was made by Prof. B. W. Evermann, of the U. S. Fish Commission, during the months of November and December, 1891, while engaged in an investigation of the fresh and salt waters of eastern Texas, with a view to the establishment of a hatchery. While the collection contains no new species, it is interesting from the fact that it extends the limits of many species and furnishes new localities for others. Those species which have not been hitherto recorded from a locality so far south, are as follows: *Panopeus depressus*, *Callinectes hastatus*, *Tozeuma carolinensis*, *Palæmonetes vulgaris*, *Palæmonetes exilipes*, *Palæmon ohionis*. *Hippa emerita* (not *talpoida* Say) has not been found further north than Cuba and Mexico. The species whose range includes Texas but which have not been previously recorded from there, are *Libinia dubia*, *Panopeus herbstii*, *Arenæus cribrarius*, *Petrolisthes armatus*, *Alpheus heterochaelis*, and *Squilla empusa*.

BRACHYURA.

1. *Libinia dubia* Milne-Edwards.
Corpus Christi; Shamrock Point, Corpus Christi.
2. *Panopeus herbstii* Milne-Edwards.
Galveston Bay.
3. *Panopeus texanus* Stimpson.
Shamrock Point, Corpus Christi.
4. *Panopeus depressus* Smith.
Galveston Bay.
5. *Callinectes hastatus* (Say).
Galveston Bay; jetty, Galveston; Swan Lake, Galveston; Corpus Christi; Shamrock Point, Corpus Christi; Dickinson Bayou. The specimens are all small, except one large male from Galveston Bay.
6. *Arenæus cribrarius* (Lamarek).
Corpus Christi Bay.
7. *Sesarma cinerea* (Bosc).
Swan Lake, Galveston.

ANOMURA.

8. *Petrolisthes armatus* (Gibbes).
Galveston Bay.
9. *Hippa emerita* (Linné?) Fabricius.
Galveston Bay; Swan Lake, Galveston. Easily distinguished from *talpoida* by the following characteristics: The median lobe of the front is more triangular; the lateral lobes much longer and narrower. Second joint of outer antennæ with the median spine very long, much exceeding the eyes, directed slightly outward; while in *talpoida* the spine is much shorter and directed inward. Third point of outer maxillipeds longer and narrower than in *talpoida*, the inner margin being straight or slightly concave for its anterior two-thirds instead of convex as in *talpoida*; the lobe

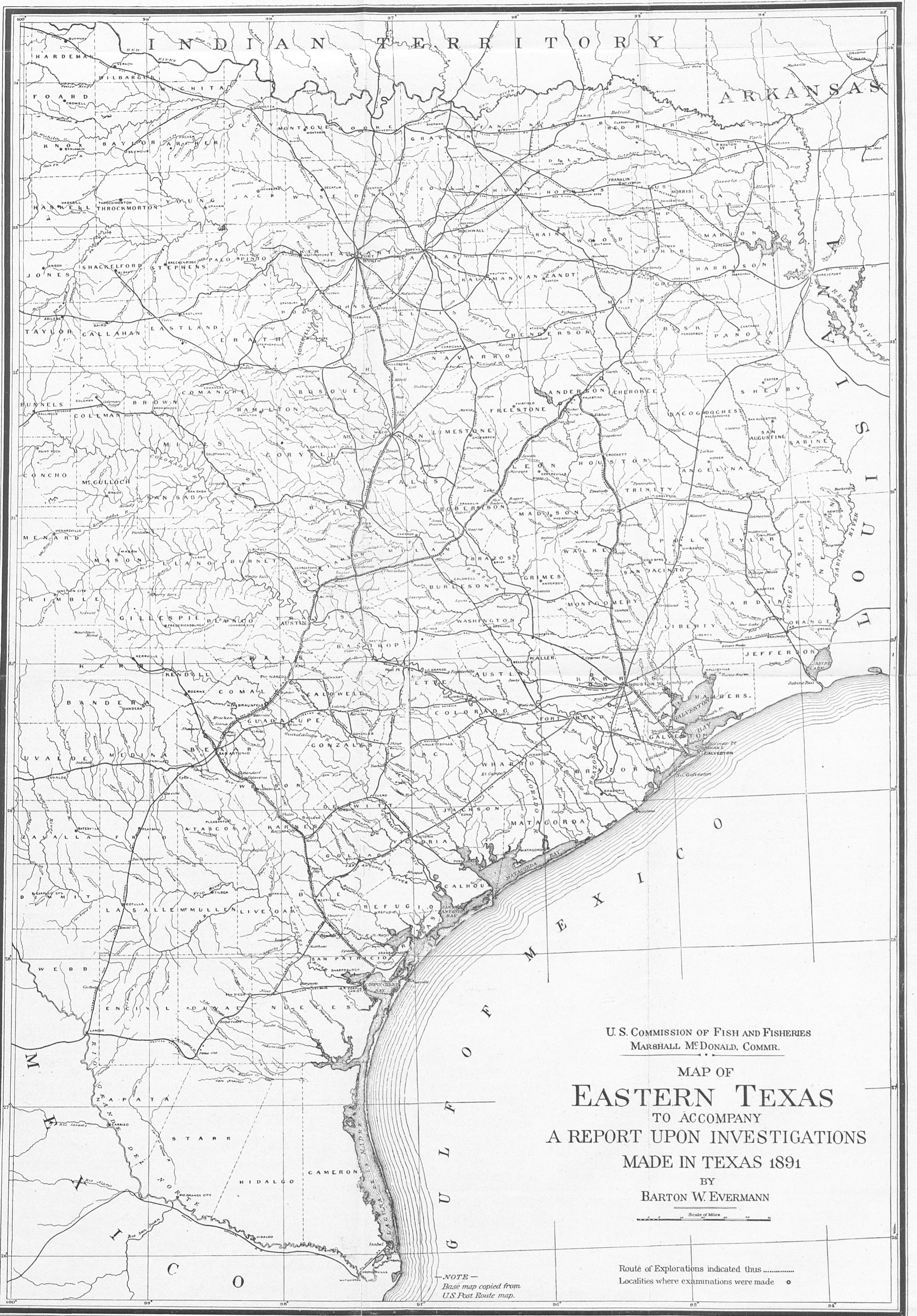
at the antero-internal angle much longer. In the specimens under discussion the terminal joint of the third pair of legs is lanceolate, but this is not characteristic of the species.

MACRURA.

10. *Tozeuma carolinensis* Kingsley.
Shamrock Point, Corpus Christi.
11. *Alpheus heterochaelis* Say.
Galveston Bay; jetty, Galveston Bay.
12. *Palæmonetes vulgaris* (Say).
Galveston Bay; Swan Lake, Galveston; Corpus Christi; Dickinson Bayou. The specimens agree in having the tip of the rostrum devoid of spines.
13. *Palæmonetes exilipes* Stimpson.
Neches River, fourteen miles east of Palestine; Magnolia Point, Trinity River; Kilper's Pond, Houston; Big White Oak Bayou, two miles south of Houston; Corpus Christi. While as a rule the rostrum has seven or eight teeth above and two below, one specimen has nine above and three below, and several specimens with eight above have three below. The single specimen from Corpus Christi is the only one in which the rostrum exceeds the antennal scales.
14. *Palæmon ohionis* Smith.
Long Lake, Palestine; Magnolia Point, Trinity River; Big White Oak Bayou, two miles south of Houston.
15. *Penæus setiferus* (Linné).
Galveston Bay; jetty, Galveston Bay; Swan Lake, Galveston; Corpus Christi.
16. *Penæus brasiliensis* Latreille.
Galveston Bay; Swan Lake, Galveston; Corpus Christi Bay; Corpus Christi.
17. *Cambarus clarkii* Girard.
Swan Lake, Galveston. One young male.

STOMATOPODA.

18. *Squilla empusa* Say.
Jetty, Galveston Bay.



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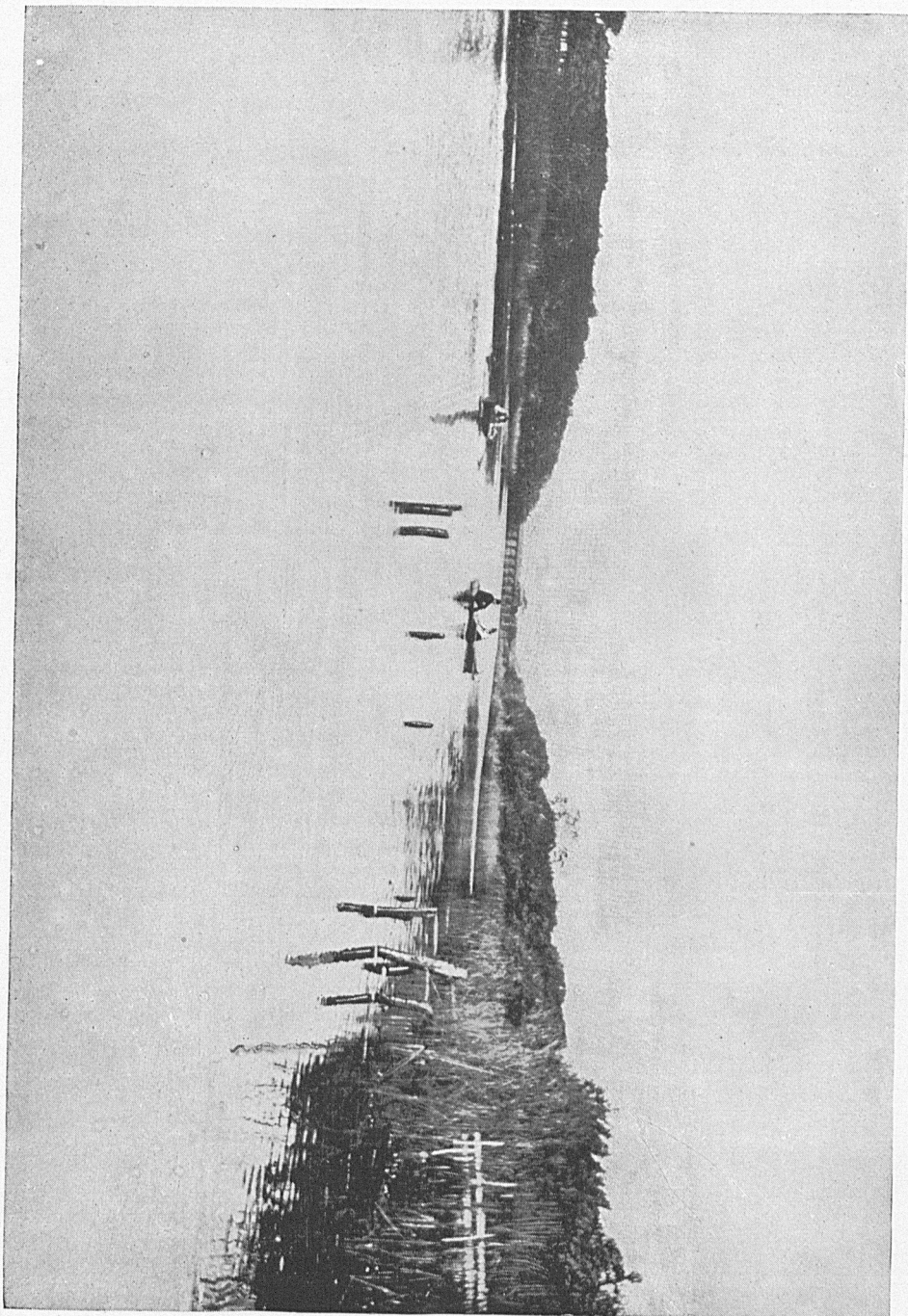
MAP OF
EASTERN TEXAS
TO ACCOMPANY
A REPORT UPON INVESTIGATIONS
MADE IN TEXAS 1891

BY
BARTON W. EVERMANN

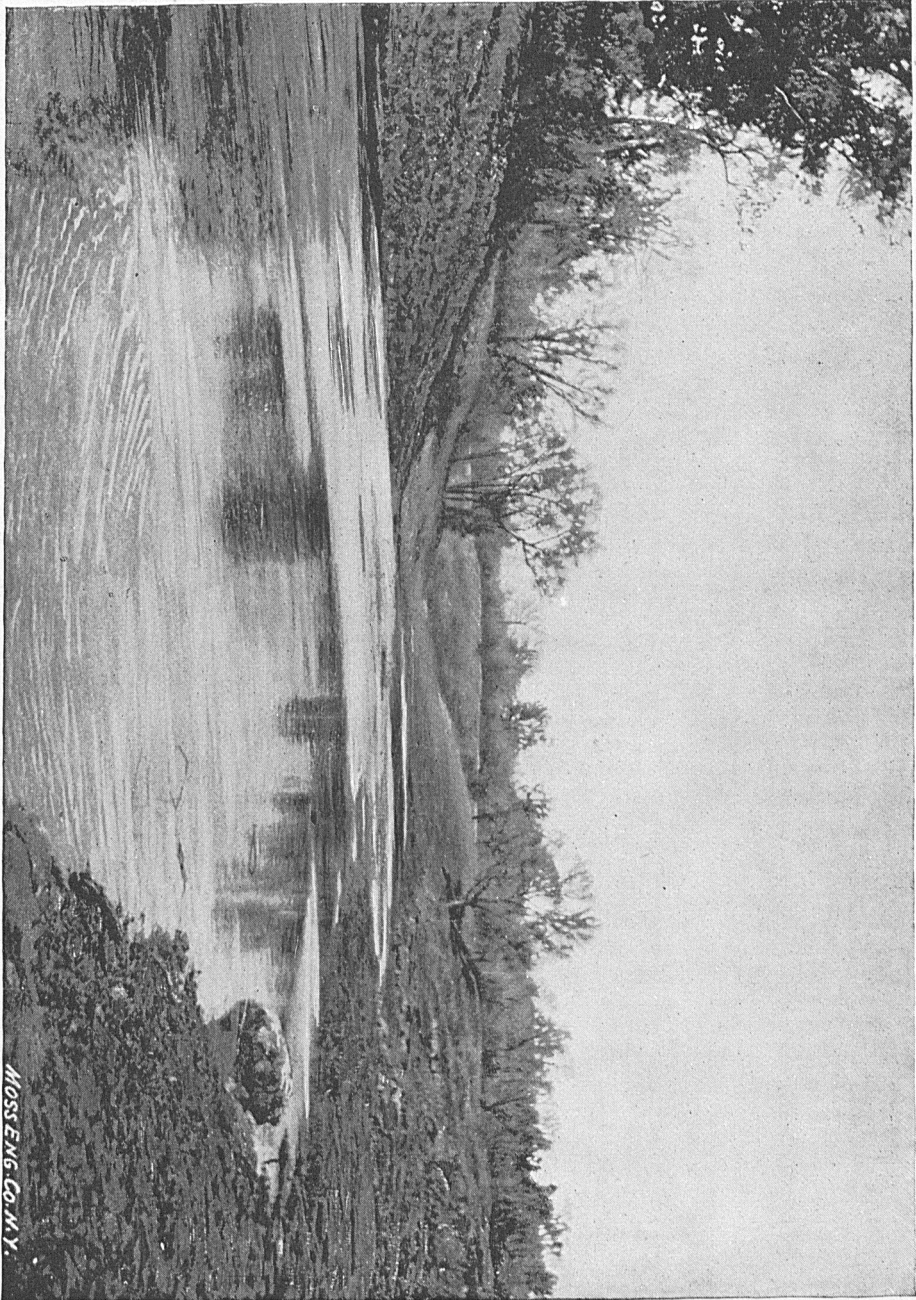
Scale of Miles

NOTE—
Base map copied from
U.S. Post Route map.

Route of Explorations indicated thus
Localities where examinations were made ○

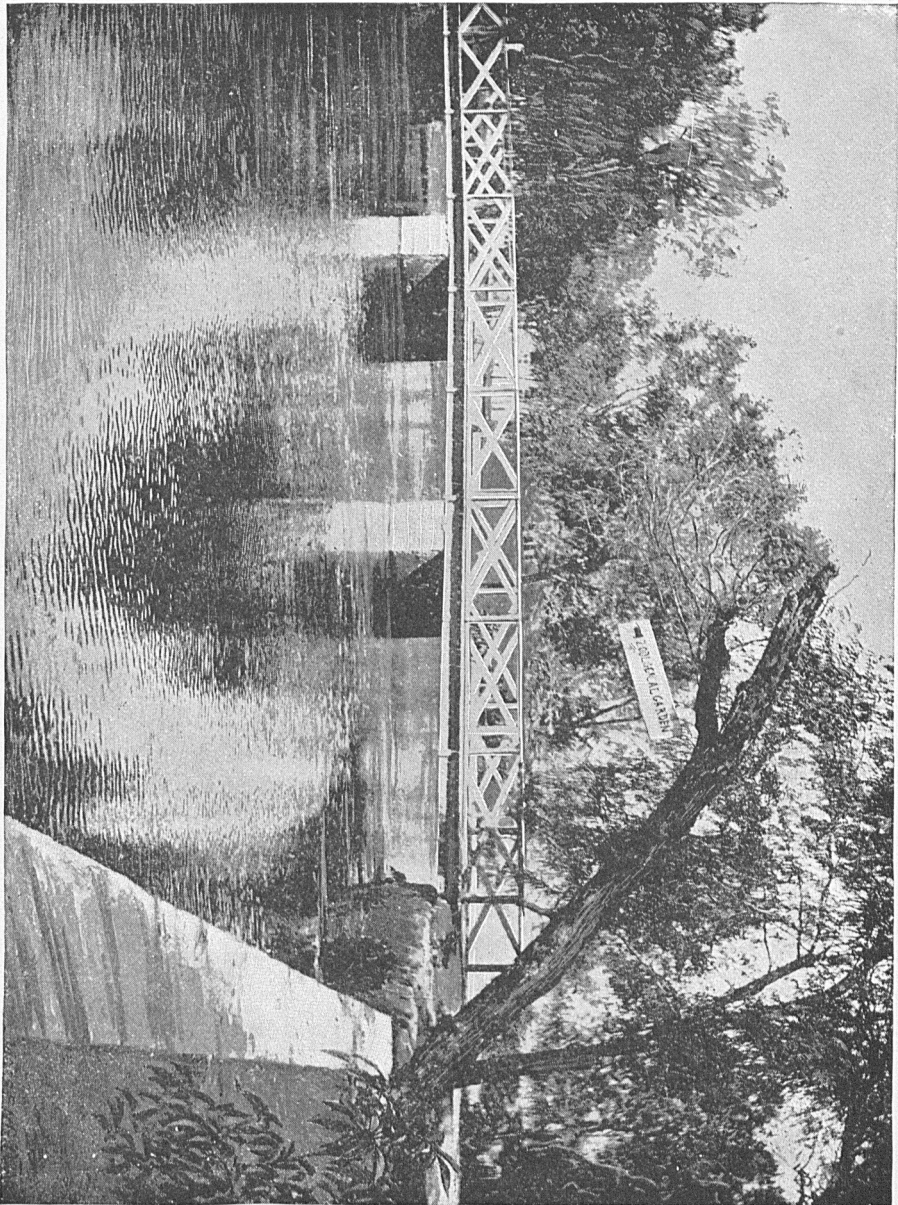


DICKINSON BAYOU, UPSTREAM FROM NICHOLSTONE, DICKINSON, TEXAS

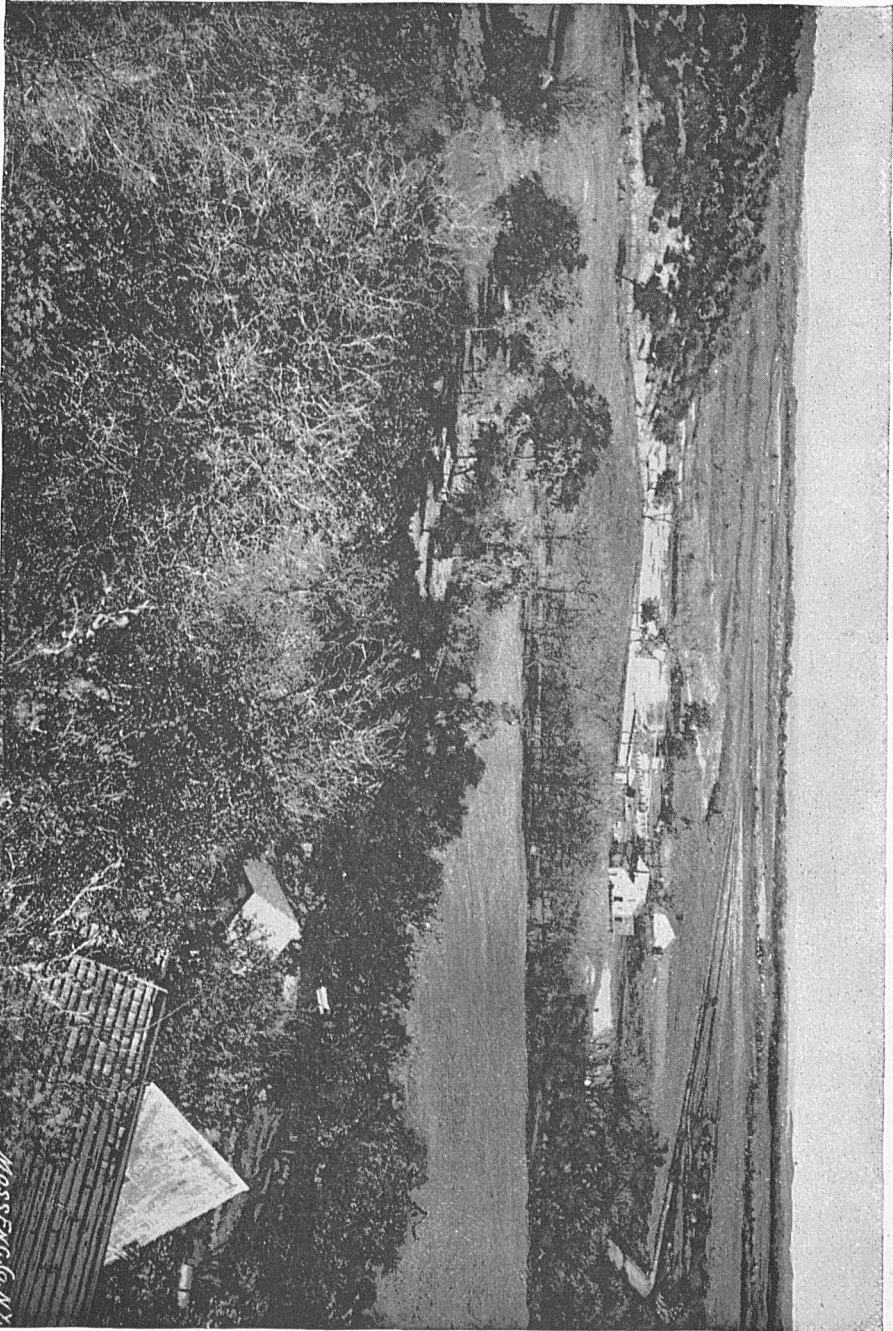


TRINITY RIVER NEAR MAGNOLIA POINT, TEXAS.

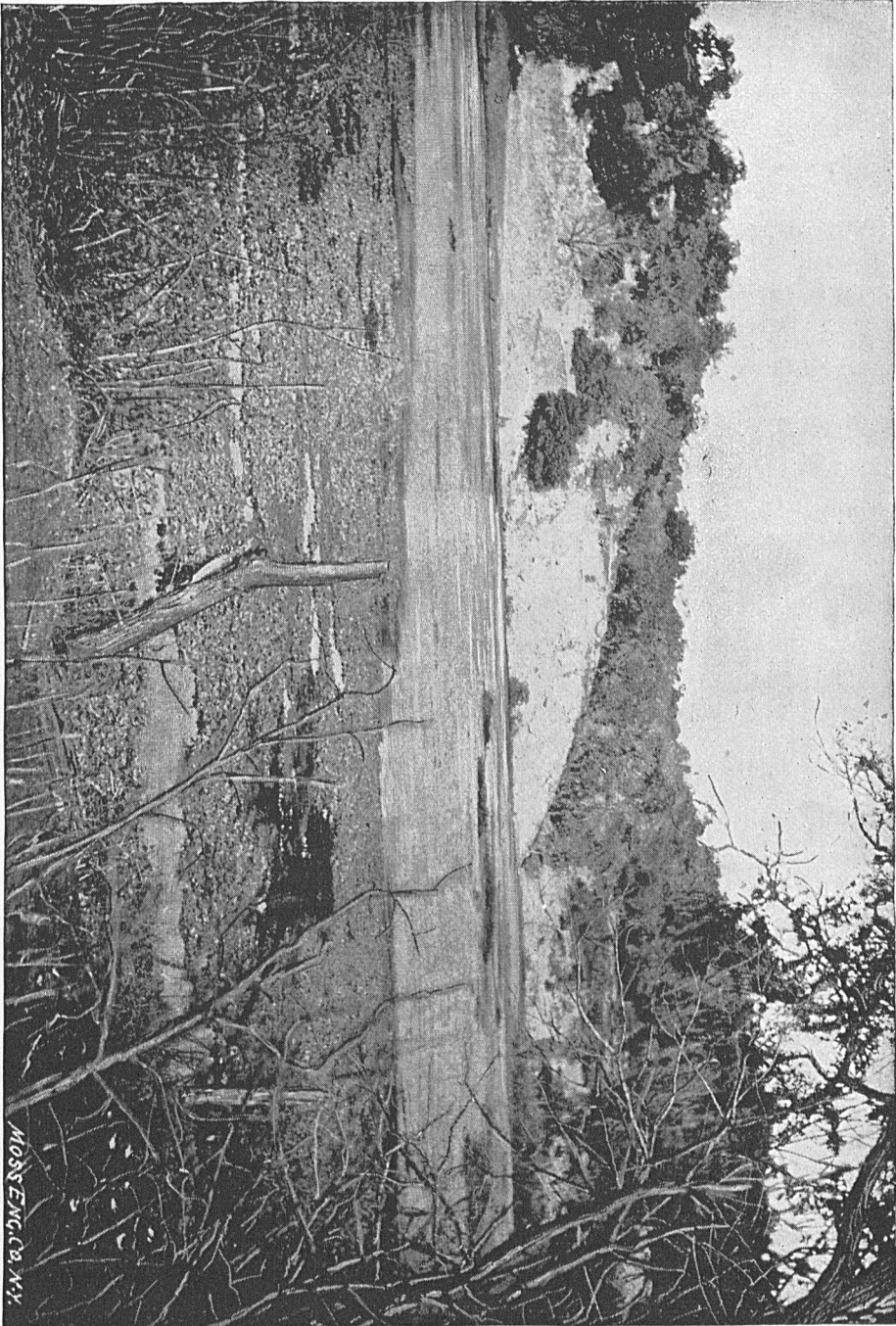
MOSS ENG. CO. N. Y.



FISH POND AT SAN PEDRO SPRINGS, SAN ANTONIO, TEXAS.

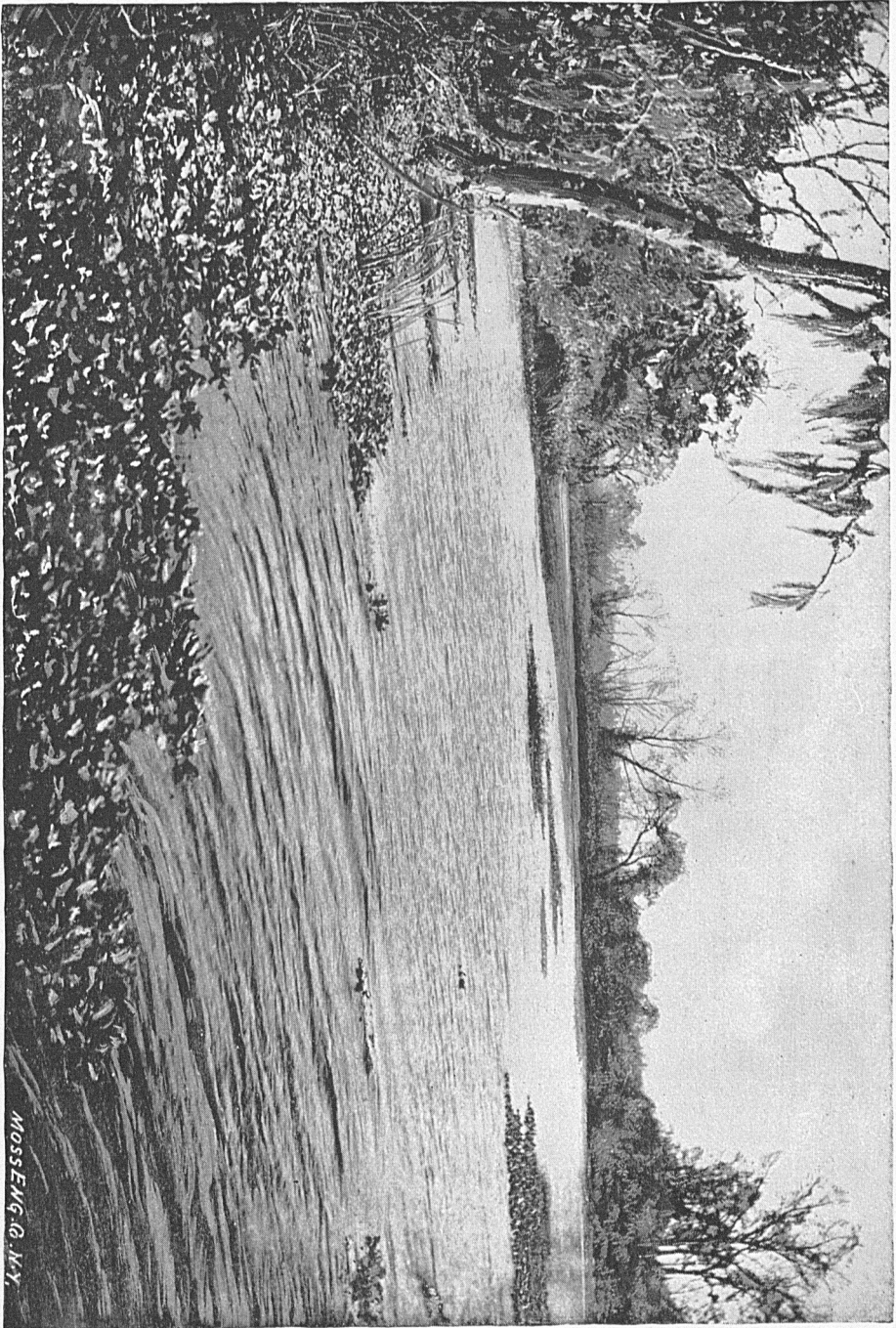


SAN MARCOS RIVER AT THE MILL, SAN MARCOS, TEXAS.



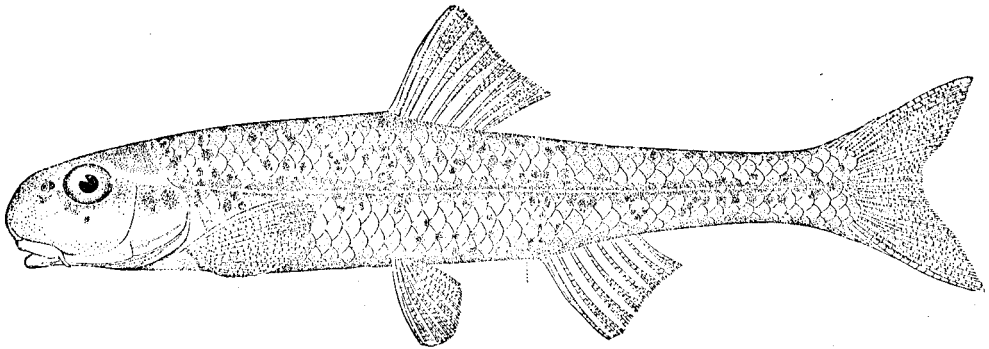
SAN MARCOS SPRING, SAN MARCOS, TEXAS.

MOSBY ENG. CO. N.Y.

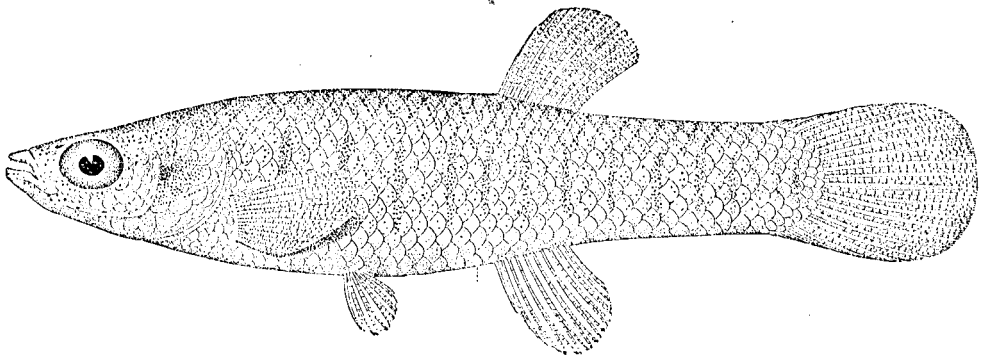


SAN MARCOS SPRING, SAN MARCOS, TEXAS. (WAVER PRODUCED BY SPRING WELLING UP FROM BELOW.)

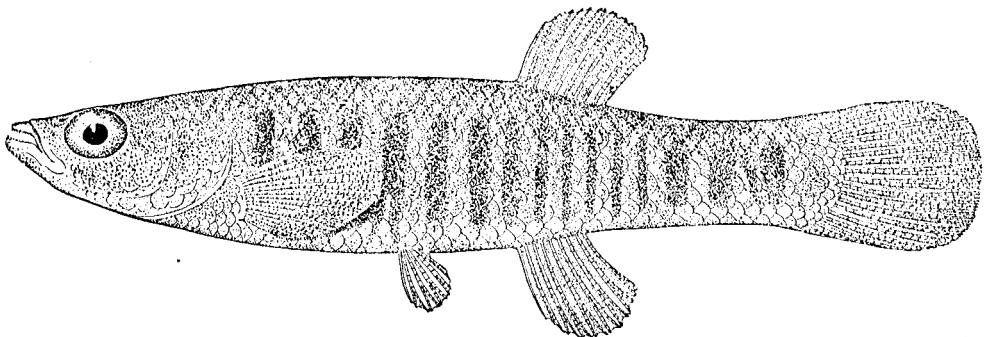
MOSS ENG. & N.Y.



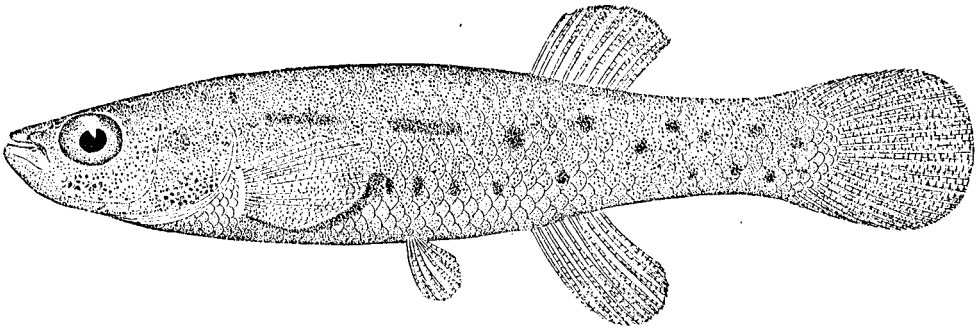
1. *HYBOPSIS ÆSTIVALIS* MARCONIS J. and G. About twice natural size.



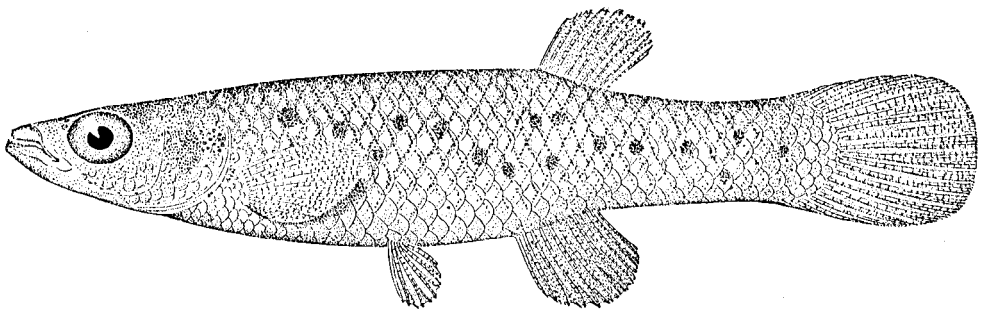
2. *FUNDULUS PALLIDUS*, sp. nov. About three times natural size.



3. *ZYGONECTES FUNDULOIDES*, sp. nov. About three and a half times natural size.



1. ZYGONECTES PULVEREUS, sp. nov. About three times natural size.



2. ZYGONECTES JENKINSI, sp. nov. About three times natural size.