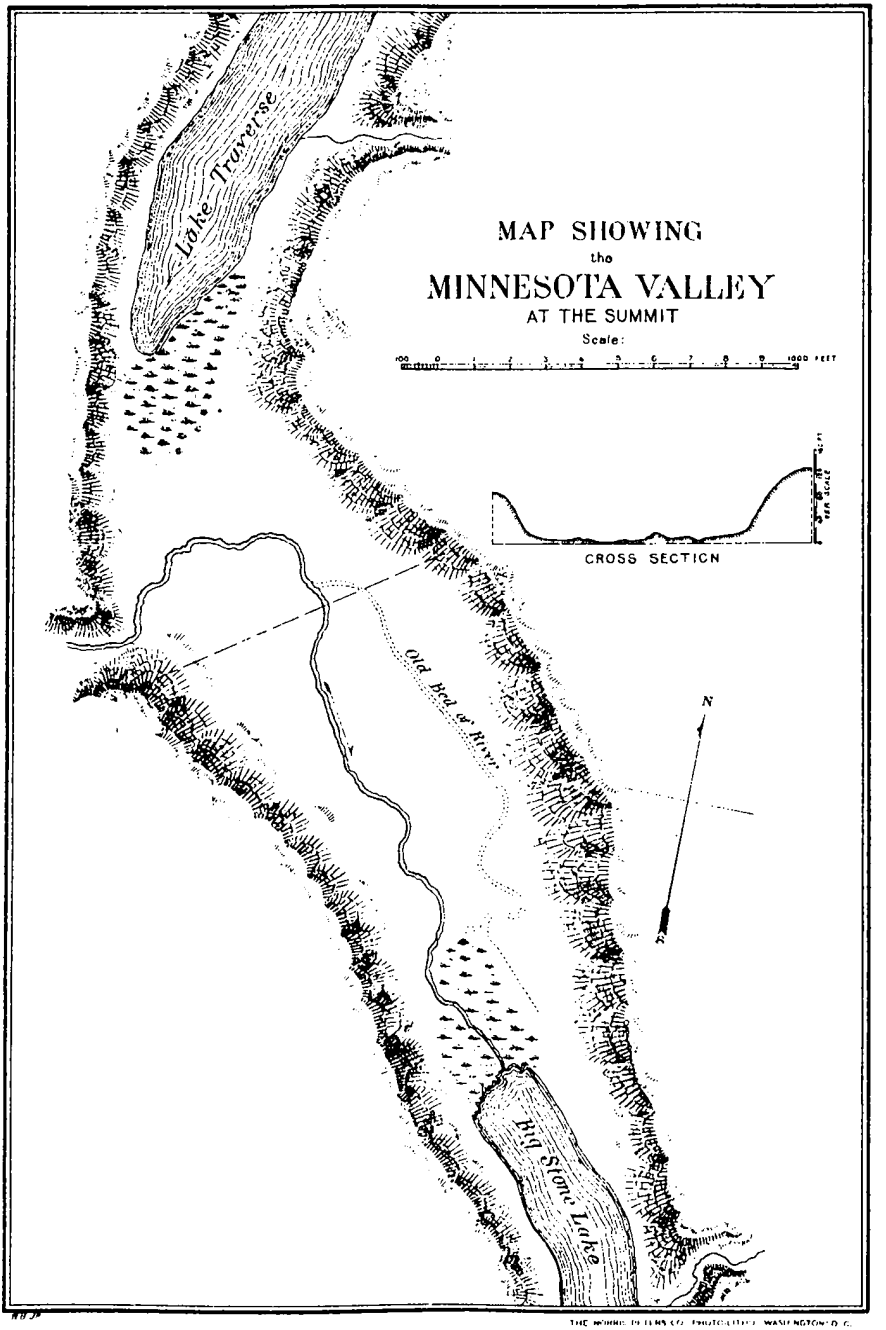
MAP SHOWING
the
MINNESOTA VALLEY
AT THE SUMMIT
Scale:
CROSS SECTION
Lake Traverse
Old Bed of River
Big Stone Lake
N

3.—A REPORT UPON ICHTHYOLOGICAL INVESTIGATIONS IN WESTERN MINNESOTA AND EASTERN NORTH DAKOTA.

By Albert J. Woolman, A. M.

INTRODUCTION.

The field work described in this report was carried on during the months of July and August, 1892. The writer was assisted during the first part of the season by Ulysses O. Cox, instructor in biology in the State Normal School, Mankato, Minn. The work was conducted under instructions from the United States Commissioner of Fish and Fisheries, Hon. Marshall McDonald, and under the immediate direction of Mr. Richard Rathbun, assistant in charge of inquiry respecting food-fishes.

The object of the investigation was to examine the physical features of Big Stone and Traverse lakes, and to make a careful study of the fishes found in them for the purpose of comparing and contrasting the forms found in these two great river systems—the Minnesota and Red River of the North—this being the place where they most nearly approach; to observe and record any items of interest bearing on the fishes indigenous to these waters, and to note any other facts that would in any way bear on fish-culture, such as geological features, water supply, vegetation, food supply, and contamination of water.

In the identification of species I have been assisted by Dr. Barton W. Evermann, of the United States Fish Commission, and Dr. Carl H. Eigenmann, of the University of Indiana.

The basins and river systems were studied in the following order:

- Lake Traverse Basin:
  - Lake Traverse.
  - Daugherty Creek.
  - Muslinka River.
- Big Stone Lake Basin:
  - Little Minnesota River—
    - At Browns Valley.
    - Near Sisseton Indian Reservation.
    - At the head of Big Stone Lake.
  - Big Stone Lake at Creager's Farm and Ortonville, Minn.
- Minnesota River Basin:
  - Wheatstone Creek.
  - Pomme de Terre River.
  - Chippewa River.
  - Minnesota River at Ortonville and Montevideo, Minn.
  - James River at La Moure and Jamestown, N. Dak.
  - Pipestem River.
- Red River of the North and tributaries:
  - Red River of the North at Moorhead, Minn., and Grand Forks, N. Dak.
  - Otter Tail River.
  - Cheyenne River at Lisbon and Valley City, N. Dak.
  - Maple Creek.
  - Buffalo River.
  - Goose River.
  - Red Lake River at Grand Forks and Crookstown, N. Dak.
  - Pembina River.
  - Tongue River.
  - Forest River.
  - Park River.

THE RED RIVER OF THE NORTH.

The Red River of the North is the only large stream within the borders of the United States that finds a northern outlet for its waters. Its course is down a long, gentle slope culminating in a low watershed that separates this system from that of the Mississippi on the south, east, and west. This divide in no place reaches the dignity of a mountain range, but is low, and in places broad and level, and is composed entirely of drift brought down from the northeast and north during glacial times. Maps represent the Red River of the North as the outlet of Lake Traverse and as a broad, marshy river in its upper course. But it is not the outlet of this lake nor has it been for many years. Neither is it broad and marshy as a river.

It is evident that the long trough occupied by Lake Traverse, Big Stone Lake, the Minnesota River, and the Mississippi River was at one time a magnificent waterway draining an inland lake greater in area than Lake Superior. This old river channel has been scooped out 150 to 200 feet below the surrounding country, and is 1 or 2 miles wide, retaining this width with remarkable constancy throughout its 300 miles or more of length.

TRAVERSE AND BIG STONE LAKES.

These two large lakes occupy that part of the valley of "River Warren" that lies between the parallels of 45° 15′ and 45° 55′ north. This section of the valley is over 1¼ miles wide, and of an average depth of 145 feet. The general direction of the valley is north and south, although the middle of this section is strongly curved to the west. The two lakes are about 5 miles apart, separated by sediment piled a few feet above the surface of Traverse Lake. This deposit separating the two lakes is not, however, the divide between the two river systems; the main divide or highest land lies to the north of Traverse Lake. Entering the valley from the west, about a mile below Traverse Lake, is the Little Minnesota River. This stream has worn for itself a valley extending to the northwest commensurate with its size and eroding power; upon reaching the broader valley, it lost its power to erode and at once began to deposit its sediment, which it extended across the valley dividing and separating the two waters, thus forming two lakes from the one that already existed, or perhaps damming the stream before Big Stone Lake had been formed.

It is quite evident from the following that after the Minnesota River had ceased to be the outlet of Lake Winnipeg, the entire valley of 35 miles, forming the semicircle from the head of Lake Traverse to the foot of Big Stone Lake, was one lake:

(1) The granite outcrop at the foot of Big Stone Lake resisted erosion to so great an extent that during the full discharge of water down this passageway it was left projecting above that part of the bed farther

north, which became a oasis that would remain filled with water, and it naturally follows that after this water-course had ceased to receive supplies from the north, the small amount of water that would escape from this lake, with its diminishing velocity, would not erode a granite bed sufficiently to rapidly reduce the depth of this lake.

(2) The ancient shore line of Lake Traverse can be traced a mile below the present limit of the lake and would indicate a former union with Big Stone Lake since the days of active running water in this channel. The character of both the fauna and flora would bear out this theory, since the difference in vegetation in the valley and on the hillside is much more marked and pronounced between the lakes than it is below the foot of Big Stone Lake or above the head of Traverse Lake. Likewise the windings of the old bed of the Little Minnesota River would indicate little or no opposition from running waters.

The similarity of species of fishes found in the two lake basins would indicate that these two lakes had at one time been connected and that there was free water communication between the parts, while the number of comparatively unimportant and minor differences (which, however, are quite noticeable and constant, and in some cases reach almost varietal importance) show clearly the landlocked condition of the fishes of Lake Traverse and amount almost to proof that these lakes have not been united in recent years.

LAKE TRAVERSE.

Lake Traverse forms the greater part of the northwestern boundary of Traverse County, one of the western tier of counties in the State of Minnesota. It is a long, narrow body of water, varying from 1 to 1½ miles in width. The valley is of a regular trough shape, sloping from the top of the hills to the bottom of the lake. The water of the lake lies low in this trough, with but a narrow margin of level land between it and the steep hillsides.

The lake is shallow, with a maximum depth of 30 feet and an average of possibly 15 feet, the depth fluctuating to the extent of 2½ to 4 feet in periods of about four years. This variation is closely connected with the rainfall, but is said sometimes to happen without apparent cause. The lake at the time of our visit was about 3 feet deeper than it had been for four years. The water frequently falls so low that the large drift bowlders project from the surface of the water in the middle of the lake. The shore line is quite regular, marking a more than usual stony area in the drift. The water is warm, 77° at the time of our visit in July, and, owing to its shallowness and the high winds that stir the lake to its bed, the top and bottom temperatures are practically the same. The water is comparatively pure, never containing clay in sufficient quantities to cause it to look turbid; it is soft and contains but little mineral salts. The hills on either side of the lake are 150 to 200 feet high and composed entirely of drift, a greater part of which

is of large granite boulders which cover the ground thickly and which are piled in great heaps or walls along the southeastern shore of the lake. The bowlders lying near the lake are worn smooth by the action of the waves. Throughout the greater part of the winter the water is frozen, and frequently to the bottom, over much of the lake.

This lake has no outlet, nor is it as long as it is usually represented. Eighteen miles or more of the northern end of what is ordinarily represented as Lake Traverse is a vast meadow land over which the water does not extend. The waters would drain to the south if the present basin were filled to overflowing. The character of the ground is quite different at the opposite ends, the one being a comparatively recently formed dam and the other composed of sediment from a lake bed overgrown with rank vegetation. This great meadow is a wilderness of coarse, wild grasses, 6 to 8 feet high, interspersed with areas of smaller prairie grass that is used by the neighboring farmers for hay. It is 60 or 75 miles in length and somewhere within this area the Boise de Soux River (the nominal head of the Red River of the North) has its source. The Boise de Soux River is a small, sluggish, bayou-like stream only a few feet wide and of uncertain channel.

Traverse Lake has but two small inlets—one from the east, the Muslinka River, and one from the west that has been called Daugherty Creek. These two small streams, together with a small annual rainfall, are the only visible means of water supply. The Muslinka River, the eastern and larger of the two tributaries, is a small stream, 40 or 50 miles long, that flows only during the spring and early summer.

The lake teems with animal and plant life. Most of the water-plants of this section of the country appear to be represented, ranging from the great rushes to the tiny desmids. Bulrushes, beakrushes, nutrushes, sedges, and grasses grow in luxuriance. Several species of *Potamogeton*, milfoil, and bladderwort were observed, but the lake is particularly rich in algæ. Quantities of *Chara*, and a large, coarse *Vaucheria* grow in various places. Species of smaller filamentous algæ and desmids and diatoms are present. The vegetation in the lake does not decay on the bottom, but is washed to the shore.

The lake contains an abundance of animal life; the lower forms are present in great numbers and variety. Crustacean life is abundant. A few crawfish were observed, and the shallow waters near the shore and among the weeds and rocks were filled with *Gammarus*, while swarms of *Daphnia*, *Cyclops*, and other small forms filled the surface waters. Great numbers of insects and their larvæ sported among the stones. The families *Gyrinidæ* and *Hydrophidæ* predominated, and were each represented by several species. Molluscan life was abundant, especially univalves. The genus *Planorbis* was represented by several species; these were slowly crawling over the vegetation or floating leisurely about near the surface of the water with the broad, almost circular foot expanded and protruding just above the surface, while the

flat spiral shell hung suspended in the water. The genus *Limnæa* was more abundant, both in variety and numbers. Limpets fastened to the bottom and sides of stones were also abundant.

Though the food supply is plentiful, comparatively few fishes were found in the lake; owing to the great number of bowlders thickly strewn over the bottom of the lake the seine could not be used to good advantage, but from observation and what could be learned from local fishermen, about the only food species taken are pickerel (*Lucius lucius*), catfish (*Ameiurus nebulosus*), and a few strawberry bass (*Pomoxis*); nor are these varieties as abundant as in former years. No small fishes were observed in the lake proper, and frequent attempts with hook and line failed.

The two tributaries of Lake Traverse were examined, which completed the work in this lake.

The specimens obtained give a fair representation of the fish fauna of this basin.

Daugherty Creek, Browns Valley, Minnesota, July 13, 1892.—This is the largest western tributary of Lake Traverse. It flows into the lake about 8 miles from the southern end, and is only a meadow brook 8 or 10 miles long, the outlet of two small "grass lakes." The stream will average 6 feet in width and has a rapid current in the narrow places. The depth of the water varies from 1 to 3 feet. The bed of the stream is of gravel and coarse stones. The banks are overgrown with grass and other prairie vegetation, but no trees are to be found. In the more quiet places the water is matted with water vegetation, *Potamogeton, Myriophillum, Sagittaria, Lemna*, and a few species of algæ. The temperature of the water was 67°.* Numerous small crustaceans and insects sported among the tangled vegetation. As a southern tributary to this stream, a small spring brook added its waters, which were much cooler, 62°. The stream is well stocked with fish, but of few species. During the spring pickerel (*Lucius lucius*) ascend to spawn, and we were informed on good authority that they sometimes fill the stream and can be thrown upon the bank with forks or shovels in large numbers.

Muslinka River, Wheaton, Minn., July 22.—This river rises in the central portion of Grant County, Minn., flows a general southeasterly direction for 25 miles, and joins Lake Traverse at its head, or northern end. The stream lies at the bottom of a broad, shallow valley, one-half to three-fourths mile in width, and is by far the largest and longest tributary of this lake, but it is little more than "a wet-weather drain." It is long and winding, with low banks and a current that moves so slowly that its motion is almost imperceptible; it does but little, except during the season of greatest rainfall, to replenish the waters of the lake. The stream will average 18 feet in width and 2½ feet in depth.

* The temperatures given in this paper are in Fahrenheit degrees, and were determined by means of a Wilder protected thermometer.

The banks are low and without trees, the prairie grass and other vegetation growing to the water's edge. The bed of the stream is of small gravel, mud, and decayed vegetation, from which grow rushes, pondweeds, and bladderworts (*Utricularia*). The stream was almost entirely devoid of fish life, owing, no doubt, to its having no direct communication with the lake for several months in the year.

Two species of fish were taken, *Lucius lucius* and *Notropis megalops*, and these were very rare. Crawfish were particularly abundant, and one species of water-snail (*Limnæa*) was also abundant. Temperature of the water, 78°; of the air, 75°, cooled by the recent rains.

The following is a list of fishes taken from Lake Traverse basin. The measurements are given in millimeters unless otherwise stated.

ANNOTATED LIST OF THE FISHES OF LAKE TRAVERSE BASIN.

1. **Pimephales notatus** (Rafinesque). *Shiner; Creek Shiner.* Daugherty Creek at Browns Valley, rare. Shape and color much like *P. promelas;* head black, snout blunt; fins dark, snout and lower jaw turbercled; lateral line with 40 scales, not distinct anteriorly.
2. **Notropis megalops** (Rafinesque). *Common Silverside; Brook Shiner.* Muslinka River at Wheaton, 5 specimens. Daugherty Creek at Browns Valley, abundant. This species was particularly abundant. Specimens very dark—much darker than those from Little Minnesota River. Lateral line black; body slightly deeper than in those from Little Minnesota River.
3. **Rhinichthys cataractæ dulcis** (Girard). Daugherty Creek at Browns Valley, 10 specimens. Not common. Body moderately elevated; shoulders heavy; caudal peduncle compressed, but deep; head medium or small; line from snout to top of shoulders slightly concave; eyes small; mouth horizontal and small, maxillary reaching about half the distance from snout to eye. Color dark, almost black above, mottled with black blotches which extend to the lateral line; belly, cheeks, and lower jaws light; dorsal and caudal fins dark; ventral and anal fins light; rays of anal longer than those of any other fin, nearly as long as head; ventrals half as long as anal; dorsal, 7; anal, 7; scales, 63 to 70.
4. **Hybopsis kentuckiensis** (Rafinesque). *Chub; River Chub.* Daugherty Creek at Browns Valley, common. Color dark; caudal spot conspicuous in all specimens. Head 3½ in body.
5. **Semotilus atromaculatus** (Mitchill). *Horned Dace.* Daugherty Creek at Browns Valley, abundant.
6. **Lucius lucius** (Linnæus). *Pike; Northern Pickerel.* Muslinka River at Wheaton, 12 specimens. Daugherty Creek at Browns Valley, abundant. Traverse Lake, not common. This is about the only food-fish in Traverse Lake. It ascends the creeks in great numbers in the spring of the year to spawn.
7. **Eucalia inconstans** (Kirtland). *Brook Stickleback.* Daugherty Creek at Browns Valley, 12 specimens. Color, dark olive with tessellations on sides; males almost black. This species prefers the cold water and sheltered places.

BIG STONE LAKE.

The valley occupied by this lake is very similar in character to that occupied by Lake Traverse. There is a more marked slope of the surface of the country to the south than to the north. The country to

the south has suffered more from erosion, deep ravines and waterways having been cut through the drift, and in places touch bedrock. Big Stone Lake is from 35 to 38 miles long and from 1½ to 2 miles wide. The lake lies in more curves than Traverse and is less regular in width. It exceeds Lake Traverse in depth, its maximum depth being 35 feet. The bottom is of sand, and in some places a few inches of mud, strewn with bowlders of various sizes. The temperature of the water at surface and bottom is practically the same, owing to the frequent winds that stir the water to the bottom. This body of water is subject to less fluctuation in depth than Lake Traverse, on account of the outlet, which the latter does not possess.

The water contains but little mineral matter and is always clear and fresh. The lake is said to be supplied with water from large springs in the bottom, but nothing of the kind was observed, though several fine springs along the eastern shore were visited. Besides the springs and the direct surface drainage from a comparatively small area, the lake receives the inflow from Little Minnesota River. The banks, which for the most part are of the same slope and are almost continuous with the higher hills, are composed entirely of drift material, no outcrop occurring except at the foot of the lake. The shore is skirted with a narrow belt of small timber that offers protection and shade. There is very little vegetation in the water. Around the inlet and outlet are a few acres of rushes, and these are bordered by a small area of submerged vegetation.

The lake is covered with ice during the winter, though it never freezes to the bottom. Fish food, such as water insects, larvæ, crustaceans, and mollusks, is not as abundant as in Lake Traverse, yet the supply is apparently sufficient. Two species of water-snail are common, and a few shells of *Anodonta* were observed. It was also reported that these bivalves were numerous about certain islands in the lake.

The young of *Catostomus teres* and *Moxostoma macrolepidotum*, together with *Percopsis guttatus* and a few species of *Etheostoma* and *Notropis*, were also common.

The lake is well stocked with several varieties of good food-fishes, foremost among which are pickerel (*Lucius lucius*), bass (*Micropterus salmoides*), wall-eyed pike (*Stizostedion vitreum*), rock bass (*Ambloplites rupestris*), and crappie (*Pomoxis sparoides*).

The pickerel is one of the most abundant species; specimens weighing from 8 to 12 pounds are often obtained. It is easily taken with the hook, almost anything that will satisfy its voracious appetite or attract its attention serving for bait. The large-mouth black bass is the favorite of the angler, since much more skill is required in its capture. Almost any bait will suffice to take this species here, but the young of *Carpiodes velifer*, 1½ to 2 inches long, and *Fundulus diaphanus*, of about the same size, are found most frequently in bait buckets, while the smaller species of *Pimephales* and *Ethcostoma* are not infrequently used.

White or silver bass (*Roccus chrysops*) are common and very abundant in April and May about the mouth of Little Minnesota River or in any other inlet. This species is said to take a fly almost as readily as does a trout, and is captured in this way or with a small minnow. It attains a weight of from 2½ to 3½ pounds, and is a luxury when brought to the table. Yellow perch (*Perca flavescens*) can be taken in large numbers, while large specimens of the two most abundant varieties of sunfish (*Lepomis pallidus* and *Lepomis megalotis*) can be taken from a boat or at almost any point along the shore. Catfish (*Ameiurus nebulosus*) are taken, but are not valued as food. The sheepnose, or grunter (*Aplodinotus grunniens*), is also common, reaching a weight of 6 or 8 pounds, but the larger ones are not prized as food, the flesh being tough and unpalatable, especially after the spawning season.

A sucker (*Ictiobus cyprinella*?) grows to a very large size in this lake. It remains in deep water near the bottom during the day, but is speared at night, when it enters the more shallow water to feed.

Big Stone Lake, Creager's farm, July 16, 1892.—The water at this place, 12 miles from the head of the lake, will average 14 or 16 feet in depth, and the lake is at that point a mile wide. The shore consists of a series of gentle curves and sharp points. The bed of the lake is in places smooth and sandy and at others very rocky, the rocky bays usually alternating with the smooth sandy bottom of the points. The shore, especially on the south side, is skirted with small trees and bushes, of which elm, oak, and box-elder are the most common varieties. At this place we spent an entire day collecting. The fishing was done with a 250-foot seine. Though the bottom of the lake was somewhat stony, the work was very successful, and not only a fair representation of the species of the fish was obtained, but also an indication of the abundance of each species. Every haul of the seine landed perch, bass, suckers, pickerel, white bass, and sunfish. *Percopsis guttatus* was also taken in large numbers.

Big Stone Lake, Ortonville, Minn., July 19, 1892.—Ortonville is at the foot of Big Stone Lake and at the junction of the Wheatstone and Minnesota rivers. The surrounding hills are very high and have been eroded into somewhat rugged cliffs. The banks are well timbered on the south side, along which the bays and inlets are well shaded. The bottom of the lake is composed of sand, thickly strewn with bowlders. The water is not deep, and the bed slopes gradually up toward the foot of the lake and toward the shores. The coves along the eastern bank are filled with granite bowlders, and the points of land extending into the water are composed entirely of this material. The water is clear, containing less vegetation than at the head of the lake. A few rushes grow about the outlet, and the bottom in more shallow places is covered with *Chara* and *Potamogeton*. Water insects and small crustaceans were observed, but were not abundant. The variety of fishes was much

greater than at the head of the lake. The following is a list of the fishes taken from Big Stone Lake and its tributaries:

ANNOTATED LIST OF THE FISHES OF BIG STONE LAKE AND TRIBUTARIES.

1. **Ameiurus nebulosus** (Le Sueur). *Catfish; Bullhead.* Little Minnesota River at Browns Valley, 1 large specimen; Big Stone Lake at Ortonville, 5 specimens; Big Stone Lake at Creager's farm, 3.
2. **Catostomus teres** (Mitchill). *White Sucker; Brook Sucker.* Little Minnesota River at Browns Valley, common; Big Stone Lake at Creager's farm, 25 specimens; Big Stone Lake at Ortonville, 10; Little Minnesota River near Indian Agency, 5. At no place were large specimens of this species taken except at Creager's farm, where a large seine was used and several specimens from 12 to 15 inches long were obtained.
3. **Moxostoma macrolepidotum duquesnei** (Le Sueur). *Redhorse; White Sucker.* Little Minnesota River at Browns Valley, 2 specimens; Big Stone Lake at Creager's farm, 16; Big Stone Lake at Ortonville, common. The specimens taken from the river were light in color, with little variation. Those taken from the clearer waters of the lake were steel-blue above, with sides and belly white.
4. **Pimephales notatus** (Rafinesque). *Minnow.* Big Stone Lake at Creager's farm, 6 specimens; Big Stone Lake at Ortonville, 10. Those taken from the latter place were very large, with snouts tubercled.
5. **Notropis deliciosus** (Girard). Little Minnesota River at Browns Valley, 2 specimens; Big Stone Lake at Ortonville, 4.
6. **Notropis megalops** (Rafinesque). *Common Shiner.* Little Minnesota River at Browns Valley, abundant; Little Minnesota River near Indian agency, 10 specimens; Big Stone Lake at Creager's farm, 7; Big Stone Lake at Ortonville, 9. Those taken from the Little Minnesota River were noticeably lighter in color than those from Lake Traverse Basin.
7. **Notropis atherinoides** Rafinesque. Big Stone Lake at Creager's farm, 1 very large specimen. Lateral line with 38 scales. Color dark olive, with sides and belly covered with a thick coat of silvery pigment.
8. **Notropis cayuga** Meek. Little Minnesota River at Browns Valley, abundant. This is a very beautiful little fish, of a light brown or olive color, with dark spots lining the edge of each scale; a dark lateral band about 2 scales in width passes entirely around the blunt snout, not touching the lower lip. This lateral stripe is overlaid with a light coat of silvery pigment; above and bordering this stripe is a distinct narrow line of a lighter color; dorsal line not distinguishable. Back not arched; lower jaw not horizontal, and projecting.
9. **Notropis hudsonius** (Dewitt Clinton). Little Minnesota River at Browns Valley, 4 specimens; Big Stone Lake at Creager's farm, 2 specimens. This fine minnow is known to inhabit a broad area in the valley of the Red River of the North and a limited area in the Minnesota River Valley. The back is slightly elevated, sloping gradually from the snout to the dorsal, the belly is of about the same curvature as the back, so that the lateral line is about the axis of the body; head medium in size, with short blunt snout; lower jaw nearly horizontal, maxillary reaching anterior edge of orbit of large eye; anterior rays of dorsal above or slightly in advance of first rays of ventral, longest dorsal ray reaching slightly beyond anterior margin of anal; caudal peduncle thick. Color, above a dark olive, with vertebral stripe the entire length of body; sides ornamented with a broad lateral stripe that extends around the snout; sides and belly covered with a satin-like pigment; lateral

line slightly curved, complete, with about 38 to 41 scales. The two specimens from the lake were somewhat darker and richer in color, with body and caudal peduncle more slender. These specimens are of the form described recently by Eigenmann & Eigenmann as *Notropis scopifer*.

10. **Hybopsis kentuckiensis** (Rafinesque). *River Chub.* Little Minnesota River at Browns Valley, 2 specimens, both small. This species apparently does not thrive in these waters as it does farther south.

11. **Percopsis guttatus** Agassiz. *Trout Perch.* Little Minnesota River at Browns Valley, rare; Big Stone Lake at Creager's farm, 20 specimens. This is apparently the most common species of small fish at the last-named place, where it is highly prized for bait by the local fishermen. It was taken near shore in about 4 feet of water and usually from over a sandy bottom.

12. **Fundulus diaphanus** (Le Sueur). *Mud Minnow; Top Minnow.* Big Stone Lake at Creager's farm, 7 specimens; Big Stone Lake at Ortonville, 12, taken in shallow water near the shore. Ovaries of females filled with eggs, some of which were ripe, while others were very small. The intestinal canal was filled with a peculiar pin-shaped parasite about a quarter of an inch long.

13. **Lucius lucius** (Linnæus). *Northern Pickerel; Pike.* Little Minnesota River at Browns Valley, 8 large specimens; Big Stone Lake at Ortonville, 3; Big Stone Lake at Creager's farm, 12. This is the most abundant food fish of this region.

14. **Eucalia inconstans** (Kirtland). *Brook Stickleback.* Big Stone Lake at Ortonville. This species does not inhabit the lake to any extent.

15. **Pomoxis annularis** Rafinesque. *Red-eye; Straw Bass; Calico Bass.* Big Stone Lake at Creager's farm, common. An excellent food-fish, thriving in these waters.

16. **Lepomis pallidus** (Mitchill). Big Stone Lake at Ortonville, common. Great numbers are taken with hook and line; worms or insects are used for bait.

17. **Lepomis megalotis** (Rafinesque). *Blue-gill.* Taken only at Ortonville. Numbers and habits about the same as those of *L. pallidus*. Several young specimens taken with the seine.

18. **Micropterus dolomieu** (Lacépède). *Small-mouth Black Bass.* Little Minnesota River at Browns Valley, 3 specimens; Big Stone Lake at Creager's farm, 5. This species was not abundant and only very small specimens were taken.

19. **Micropterus salmoides** (Lacépède). *Large-mouth Black Bass.* Little Minnesota River at Browns Valley, common; Big Stone Lake at Creager's farm, 12 specimens; Big Stone Lake at Ortonville, common. One of the most abundant game fishes and one to which the lake seems particularly well adapted.

20. **Etheostoma aspro** (Cope & Jordan). *Black-sided Darter.* Little Minnesota River at Browns Valley, 5 large specimens. Head 4; depth 5½; dorsal IX or X–11 or 12; anal 11,7.

21. **Etheostoma nigrum** Rafinesque. Little Minnesota River at Browns Valley, 2 specimens; Big Stone Lake at Creager's farm, 15; Big Stone Lake at Ortonville, common. Color dark. Head and shoulders heavy, tapering to the long caudal peduncle; cheeks and opercles covered with scales; lateral line with 40 to 52 scales. A specimen from the outlet of Big Stone Lake is somewhat peculiar and may be described as follows: Head, 3½ (without flap, 3¼); depth, 5⅔; eye, 4½ (4 without flap), equaling snout. D. VIII–12; A. 1, 8; scales 4–49–5. Body slender, resembling *Etheostoma olmstedi* in general form, head moderate, caudal peduncle long and slender; mouth large, nearly horizontal; premaxillaries protractile; maxillary reaching vertical of pupil; gill-membranes scarcely connected. Cheeks naked or nearly so; opercles, nape, and breast scaled, belly with ordinary scales; lateral line complete, slightly arched in an anterior portion. Dorsal fin high, longest spine about 1⅔ in head, soft portion a little higher; anal rays about 2 in head, anal fin smaller than soft dorsal; its base 1⅔ in that of soft dorsal; pectoral long, as

long as head, almost reaching anal fin; ventrals short, 1⅓ in pectoral. Color of male in alcohol, dusky, with ten or eleven darker vertical bars extending from median line of back to below lateral line, the anterior ones narrow, those on posterior part of body broader; the spaces between these bars with small, dark punctulations; top and sides of head profusely punctulate; a dark suborbital spot; spinous dorsal black on membrane connecting first two or three spines, the rest of spinous part punctate, and edged with black; a small black spot on posterior part; soft dorsal more or less mottled; caudal paler, some black on tip and edges; anal profusely covered with fine dark points, thickest on edge; ventrals blue-black; pectorals pale. Length 2 inches. Found by us only in the Minnesota River at the outlet of the Big Stone Lake. Though differing somewhat from typical specimens of *E. nigrum*, our specimen is apparently a breeding male of that species.

22. **Perca flavescens** (Mitchill). *Yellow Perch; Ringed Perch.* Little Minnesota River at Browns Valley, common; Little Minnesota River near Sisseton Indian agency, 2 specimens; Big Stone Lake at Creager's farm, common; Big Stone Lake at Ortonville, common. Especially numerous in Big Stone Lake.

23. **Stizostedion vitreum** (Mitchill). *Wall-eyed Pike; Pike Perch.* Big Stone Lake at Creager's farm, 6 specimens; Big Stone Lake at Ortonville, 4. An excellent food-fish and frequently taken.

24. **Aplodinotus grunniens** Rafinesque. *Sheepshead; White Perch; Croaker.* Little Minnesota River at Browns Valley, 2 specimens; Big Stone Lake at Creager's farm, 5; Big Stone Lake at Ortonville, 2. This species reaches a weight of 4 to 6 pounds, but is not much prized as food. It is much sought after by the boys for the otolith of the ear—"luck stones in the head."

MINNESOTA RIVER.

The Minnesota River is 255 miles long and occupies a deep, somewhat regular valley from 150 to 250 feet below the level of the surrounding country, and from 1½ to 2½ miles wide. The upper part of this valley extends from Traverse Lake to Mankato in a southeasterly direction for 175 miles. The lower course extends from Mankato in a northeasterly direction to the Mississippi River, 7 miles below the falls of St. Anthony. The river is subject to great fluctuations, as is shown by the flood-plain, which is frequently more than one hundred times the width of the river. The bed is of sand and mud. Huge sand-banks along the shores and in the middle of the stream are common.

Ortonville, Minn., July 18, 1892.—The Minnesota River was examined a mile below Big Stone Lake, just below the mill. The river here during the summer season is a mere brook, winding among the knobs of granite that outcrop in the valley. The size of the stream at the outlet of the lake can scarcely be estimated, since half a mile below it receives a western tributary, the Wheatstone, and a mile below the foot of the lake it is dammed, so that the waters of the two streams are collected, forming a marshy mill-pond from the dam to the lake. Below the dam the course of the river is almost straight for half a mile, and here it is from 3 to 5 miles wide and from 12 inches to 2 feet deep, with a current of possibly 1½ to 2 miles per hour. The immediate banks are low and fringed with willows, and the bed is of fine sand and gravel. In addition to the waters from the lake and the Wheatstone the stream

is fed by a few cold springs which bubble from the sand below the mill-dam. Small fish were numerous below the dam, every haul of the seine landing great numbers of *Ictiobus carpio*, *Pimephales notatus*, and young black bass.

Montevideo, Minn., July 19.—The Minnesota River at this place, after flowing 45 or 50 miles and receiving the waters from the Yellow, Lac qui Parle, Pomme de Terre, and Chippewa rivers, is a stream about 100 feet wide and from 4 to 7 feet deep. The flood-plain at this place is more than a mile wide and from 8 to 15 feet above low water. The banks and hills are timbered with a growth of small trees; there is but little vegetation growing in the water. The stream has a current of possibly 2 miles per hour. The bed is of mud, very deep near the shores, and the water is of a light clay color, due to the great quantities of that material held in suspension. The locality was not a good one for making collections. Repeated efforts were made with a 45-foot seine, but comparatively few fishes were taken.

Wheatstone River, Millbank, S. Dak., July 19.—This is a small tributary, about 25 miles in length, rising in Grant County, South Dakota, about 25 miles southeast of Ortonville, flowing in a generally southeasterly direction and joining the Minnesota River almost at the place where it leaves the lake. In fact, sediment brought by this stream has possibly contributed to form the south banks of the lake, much as the sediment of the Little Minnesota River has formed the southern shore of Lake Traverse. The stream was fished at Millbank, 12 miles from its mouth. At this place it is only a meadow brook, a series of long, narrow ponds 3 to 5 feet in depth, connected by shallow ripples only a few inches in depth. The bed is of mud, and the water turbid and warm. The banks of the stream are low and devoid of all vegetable life except grasses, there being neither trees nor shrubs to shelter the water. The water contained considerable pond vegetation, and in places was covered with ditch-weed. Several species of fish, such as *Catostomus teres*, *Ameiurus nebulosus*, *Pimephales notatus*, and a great many pickerel, ascend the stream as far as Millbank to spawn.

Pomme de Terre River, Appleton, Minn., July 20.—This stream is in striking contrast to the other rivers in this vicinity. Instead of bare banks, mud bottoms, and clouded waters, here the banks were well shaded with elm, willow, and box-elder, which grew to the very margin of the stream and overhung the water, shading and in some places almost concealing the stream. The water was clear and cool, 59°, and flowed over a bed of sand and coarse gravel. The mouth of the Pomme de Terre River is 20 miles from Big Stone Lake, and 30 feet lower in altitude. It drains an area of more than 900 square miles, and discharged at the time visited about 80 cubic feet of water per second. It rises in a lake bearing the same name as the river, in Grant County, Minn., 60 miles from Appleton, which is 8 miles from the mouth. The stream is very crooked, but in a general direction flows south. At

Appleton the bed of the stream is 30 feet wide, with a flood-plain three-quarters of a mile wide. The stream receives the waters of several small lakes and tributaries, making an average depth of from 1 to 3 feet. The numerous ripples are shallow, broad, and rapid. In many places the bottom is thickly covered with a rank growth of water vegetation. This grass and weeds fasten to and about the sides of the rocks, reaching a length of from 2 to 3 feet, and forming a thick green mass which entirely hides the bed of the stream, thus affording a splendid place of concealment for small fish, two or three species of which appear to be particularly fond of this retreat.

The bed of the stream is smooth, with nothing to offer obstruction to the seine except a few granite bowlders. Collections were made just below the mill on the north side of the town, where the stream literally swarmed with fish. At this place a high dam is built across the river, which, however, is provided with a fish-ladder, the practical working of which is good. It consists of strong board boxes, 2½ by 4 feet and 14 inches deep, arranged in series, so that fish can easily pass from one to the other. When the water was drawn from the topmost box it was found to contain nearly 200 fish of various sizes, and others before the water was withdrawn could be seen passing from one box to another, and from the last box into the pond above. Crowded about the foot of the ladder were swarms of fish, principally *Catostomus*, *Pimephales*, and *Hybopsis*. A recent law of Minnesota requires the owners of dams to build and maintain fish-ladders of this pattern; and it is hoped that the law will be rigidly enforced.

Chippewa River, Montevideo, Minn., July 19.—The Chippewa River is another northern tributary of the Minnesota, and, like that river, shows signs of having served as a waterway when the supply of water was much greater than at present, the valley being totally out of proportion to the size of the present stream. The area drained by this river is much greater than that drained by the Pomme de Terre, being 1,800 or 1,900 square miles. Montevideo is near the mouth of the stream and the country around is much broken and eroded, the higher lands standing as points or knobs from around which the soil has been removed by erosion. The stream at Montevideo has a broad valley well overgrown with maples, elms, box-elder, and birch, some of which reach a considerable size and might almost be designated as forest trees. The stream flows in a southwesterly direction between the banks of drift, which are 40 feet apart. The depth of the water is about 6 feet. The bed and the banks are of mud for the most part. Three-quarters of a mile below Montevideo a ford was found at a deep, swift ripple, where the bed was of sand and gravel. Patches of waterweed along the edges and in the swifter water were the prevailing vegetation. A few crawfish were taken, and a large bed of clams was discovered, from which were taken four species.

ANNOTATED LIST OF THE FISHES OF THE MINNESOTA RIVER AND TRIBUTARIES.

1. **Lepisosteus osseus** (Linnæus). *Gar Pike; Long-nosed Pike; Needle-billed Pike.* Minnesota River at Ortonville, 1 specimen. Reported common by the local fishermen, but only a very young individual, about 4 inches long, was taken.
2. **Ameiurus nebulosus** (Le Sueur). *Common Bullhead; Horned Pout.* Minnesota River at Ortonville, 1 specimen; Pomme de Terre at Appleton, 7; Chippewa River at Montevideo, 5. No large specimens taken; average 4 or 5 inches.
3. **Noturus gyrinus** (Mitchill). Pomme de Terre at Appleton, 2 specimens; Chippewa River at Montevideo, 2. This species is rare and apparently not widely distributed in this valley.
4. **Catostomus teres** (Mitchill). *Small-scaled Sucker.* Minnesota River at Ortonville, common; Pomme de Terre at Appleton, abundant; Chippewa River at Montevideo, 1 specimen. An abundant and widely distributed species in this region, entering small streams, and apparently preferring quiet or even stagnant water.
5. **Ictiobus carpio** (Rafinesque). Minnesota River at Ortonville, very abundant above the dam; all specimens small; none exceeding 4 inches; too young for certain identification.
6. **Carpiodes velifer** (Rafinesque). *Quillback.* Pomme de Terre River at Appleton, very abundant, but specimens young.
7. **Moxostoma macrolepidotum duquesnei** (Le Sueur). *Redhorse; White Sucker.* Minnesota River at Montevideo, rare. This species apparently prefers the larger streams and lakes.
8. **Campostoma anomalum** (Rafinesque). *Stone-lugger; Stone-roller.* Wheatstone Creek at Millbank, 4 specimens; Pomme de Terre River at Appleton, 6. Rare in this region; taken only from the swift waters of the ripples.
9. **Pimephales notatus** (Rafinesque). Minnesota River at Ortonville, abundant; Pomme de Terre River at Appleton, 6 specimens; Chippewa River at Montevideo, abundant. This species was found collected below the dams of the streams and was particularly numerous below the dam in Pomme de Terre River. The largest specimens averaged 3 inches in length.
10. **Pimephales promelas** Rafinesque. Chippewa River at Montevideo, 15 specimens; Minnesota River at Ortonville, 12. Chin and snout much tubercled; the tubercles on the snout arranged in three rows, three in the first, five in the second, and seven in the third.
11. **Notropis deliciosus** (Girard). Minnesota River at Ortonville, 150 specimens; Wheatstone Creek at Millbank, common; Chippewa River at Montevideo, abundant; Pomme de Terre River at Appleton, abundant; Minnesota River at Montevideo, 5. There is a considerable difference in the size and color of specimens taken from the Minnesota River at Ortonville and those from the Chippewa River. The average measurements of the former are: Length, 56 mm.; head, 13 mm.; depth, 14 mm.; lateral line, 37; scales before dorsal, 13. Those of the Chippewa River measure as follows: Length, 47 mm.; head, 11½ mm.; depth, 11 mm.; lateral line, 36; scales before dorsal, 14.
12. **Notropis whipplii** (Girard). Chippewa River at Montevideo, 2 specimens. A very rare species in these waters. Specimens in good color, and differing only very slightly from those taken in Indiana, Kentucky, and Tennessee, where it is abundant. Average length, 2½ inches.
13. **Notropis dilectus** (Girard). Pomme de Terre River at Appleton, abundant; Chippewa, at Montevideo, 24 specimens; Minnesota River at Montevideo, 1. This species was far more abundant in Pomme de Terre River, where the largest specimens in the best color were taken. The back is olive green, the

sides, belly, and jaws dashed with carmine red, through which a silvery pigment shows. This is one of the most abundant species found in the boxes of the fish-ladder, and collected about the opening or foot of it. The one specimen taken at Ortonville differs somewhat from the other specimens. The head was more sharply pointed; back not elevated; belly decurved; lateral line parallel with belly; vertebral stripe narrow but distinct; lateral stripe wide and of a deep metallic blue; sides below lateral line washed with red. Scales in lateral lines, 40; scales before dorsal, 14.

14. **Notropis megalops** (Rafinesque). *Common Shiner; Silversides.* Minnesota River at Ortonville, common; Minnesota River at Montevideo, abundant; Wheatstone Creek at Millbank, abundant; Pomme de Terre River at Appleton, common; Chippewa River at Montevideo, common. This species is widely distributed and was very abundant at every station visited.

15. **Notropis heterodon** (Cope). Pomme de Terre River at Appleton, common; Wheatstone Creek at Millbank, 19 specimens.

16. **Notropis scopifer** Eigenmann & Eigenmann. Pomme de Terre River at Appleton, 1 specimen.

17. **Rhinichthys cataractæ dulcis** (Girard). *Dace.* Pomme de Terre River at Appleton, 2 specimens. Length, 2¼ inches. Color, very dark.

18. **Hybopsis kentuckiensis** (Rafinesque). Taken at every station in the Minnesota Valley, but the individuals were neither large in size nor abundant in numbers. There are some external differences in the specimens from various stations. Those from the Minnesota River at Ortonville were all young and light in color; those from the more stagnant waters of Wheatstone Creek are larger and quite dark; while the sides and bellies of many of the specimens from the Pomme de Terre are marked with large, dark spots.

19. **Semotilus atromaculatus** (Mitchill). *Horned Dace; Creek Chub.* Minnesota River at Ortonville, 4 specimens; Wheatstone Creek at Millbank, 4; Pomme de Terre at Appleton, abundant; Chippewa River at Montevideo, 12 specimens. This species, while far from being as abundant here as in the Middle and Southern States, was more plentiful than the last-named species.

20. **Notemigonus chrysoleucus** (Mitchill). *Golden Shiner.* Minnesota River at Ortonville, 1 specimen; Wheatstone Creek at Millbank, 5. A rare species, but the specimens are large and in fine color.

21. **Percopsis guttatus** (Agassiz). *Trout Perch.* Minnesota River at Montevideo, 3 specimens. Specimens from this locality are not so hardy as those taken from the lake.

22. **Fundulus diaphanus** (Le Sueur). *Mud Minnow; Top Minnow.* Minnesota River at Ortonville, 2 specimens; Wheatstone Creek at Millbank, 5; Pomme de Terre River at Appleton, common; Chippewa River at Montevideo, 7; Minnesota River at Montevideo, common. This species prefers the more quiet waters, and was not taken from ripples or swift currents.

23. **Lucius lucius** (Linnæus). *Pike; Northern Pickerel.* Minnesota River at Ortonville, 10 specimens; Wheatstone Creek at Millbank, common; Pomme de Terre at Appleton, 6; Chippewa River at Montevideo, 15; Minnesota River at Montevideo, 4. While this species prefers the lakes, it is by no means confined to these waters, but is common in streams and very abundant in the Chippewa River and Wheatstone Creek. It ascends the latter stream from Big Stone Lake, since the water connection during high water is almost direct.

24. **Eucalia inconstans** (Kirtland). *Brook Stickleback.* Minnesota River at Ortonville, specimens very small and poorly colored.

25. **Ambloplites rupestris** (Rafinesque). *Rock bass; Goggle-eye; Red-eye.* Minnesota River at Ortonville, 3 specimens; Pomme de Terre River at Appleton, 10; Chippewa River at Montevideo, 7; Minnesota River at Montevideo, 2. An excellent food-fish, thriving well in the lakes, but not taken in quantities from the streams.

26. **Lepomis pallidus** (Mitchill). *Blue Sunfish.* Minnesota River at Ortonville, 3 specimens. Rare in the rivers of this region; specimens all small.
27. **Lepomis megalotis** (Rafinesque). *Blue-gill.* Wheatstone Creek at Millbank, rare; Pomme de Terre River at Appleton, 3 specimens.
28. **Micropterus salmoides** (Lacépède). *Large-mouth Black Bass.* Minnesota River at Ortonville, common; Chippewa River at Montevideo, 6 specimens; reported by local fishermen very abundant in the Chippewa River and equally so above the dam at Montevideo.
29. **Micropterus dolomieu** Lacépède. *Small-mouth Black Bass.* Chippewa River at Montevideo, rare; very few specimens were taken.
30. **Etheostoma nigrum** Rafinesque. *Johnny Darter.* Minnesota River at Ortonville, 25 specimens; Wheatstone Creek at Millbank, 1; Pomme de Terre River at Appleton, 1; Chippewa River at Montevideo, 38; Minnesota River at Montevideo, 4. This is by far the most abundant darter in the streams of this region, which seem to be particularly adapted to its growth.
31. **Etheostoma aspro** (Cope & Jordan). *Black-sided Darter.* Minnesota River at Ortonville, 1 specimen; Chippewa River at Montevideo, 45. Not widely distributed in this region, nor large except at the last-named station.
32. **Etheostoma iowæ** (Jordan & Meek). Pomme de Terre River at Appleton, 12 specimens; Wheatstone Creek at Millbank, 3.
33. **Perca flavescens** (Mitchill). *Yellow Perch; Ring Perch.* Minnesota River at Ortonville, common; Wheatstone Creek at Millbank, abundant; Pomme de Terre River at Appleton, 4 specimens.
34. **Stizostedion vitreum** (Mitchill). *Wall-eyed Pike; Pike Perch.* Minnesota River at Ortonville, 3 specimens; Minnesota River at Montevideo, 2.

THE DAKOTA OR JAMES RIVER.

The James River is essentially a prairie stream rising in the southwestern part of Nelson County, North Dakota, near Devil Lake, and flowing in a general southerly direction for nearly 400 miles before joining the Missouri River. It makes its way between a low ridge or elevation on the west side and the Plateau du Coteau des Prairies on the east. The former separates it from the Missouri, and the latter from the Minnesota. It is one of the chief tributaries of the Missouri in North Dakota, but its drainage area is much restricted by the elevations on either side, and hence the amount of water it discharges is relatively small. The stream was examined at two points, La Moure and Jamestown.

La Moure, N. Dak., July 27.—La Moure is on the Fargo and Southwestern branch of the Northern Pacific Railroad, 100 miles southwest of Fargo and over 250 miles from the mouth of the river. Here the valley is not more than 10 or 15 miles wide, the hills rising gently on either side to a height of about 150 feet. The immediate valley or flood-plain of the river is about 2 miles wide, level, and very fertile. The width of the stream will not exceed 15 yards, and its depth will average 3 or 4 feet. The current is slow, not more than half or three-quarters of a mile per hour. The stream is very crooked and has low, steep banks. The bed of the stream is of fine mud, several inches deep, which is overgrown with a thick mat of pond vegetation, consisting of bladderwort, water milfoil, chara, etc., which in places grow entirely

across the channel, almost to the surface of the water. The stream was fished at Powers Ford, 3 miles north of the town, where the mud in the bed of the stream gave place to a bed of gravel and the banks were of sufficient slope to permit the landing of the seine. Temperature of the water, 81°.

Jamestown, N. Dak., August 28.—The James River was fished the second time at Jamestown, about 55 miles northeast of La Moure. The character of the country is similar to that around La Moure. The hills, however, are farther from the river. The soil contains a great many more bowlders, but these are mostly small. It is also filled with banks of coarse, water-worn gravel, containing clay and iron nodules. The river at this point is about 18 to 20 feet wide and from 2 to 3 feet deep. The stream is obstructed here by a high dam built for power purposes. The collecting was done below the dam, where the stream is composed of a series of ripples, and the water runs rapidly over a clean gravelly bed. The banks of the stream are composed of drift, covered with vegetation that grows to the water's edge. The banks are also lined with a natural growth of small timber, such as box-elder, maple, elm, and three varieties of willow. There is a scant water vegetation where the stream was examined, which covers the large stones of the bottom. A few crawfish were found, and also a few water-snails. The stream swarmed with small fishes; *Rhinichthys* was taken by hundreds; *Pimephales*, *Notropis*, and *Ethcostoma* were also well represented. The stream at this place is well adapted to darters and dace, being quite clear and cool. The temperature of the water, 60°, would indicate considerable spring water, though no springs were observed.

Pipestem Creek, Jamestown, N. Dak., July 27.—This is a small western tributary of the James River, flowing nearly parallel with, and between, the same two ranges of hills. It is about 50 miles in length, narrow and deep. It is a poor stream in which to make collections, since no ripples were to be found. The water is clear; the temperature 62°.

ANNOTATED LIST OF FISHES FROM THE JAMES RIVER.

1. **Ameiurus nebulosus** (Le Sueur). *Catfish.* Taken at La Moure and Jamestown. Specimens all small at Jamestown; several 12 inches long from La Moure.
2. **Ameiurus natalis** (Le Sueur). *Yellow Cat.* Five specimens taken at La Moure.
3. **Ameiurus melas** (Rafinesque). Taken from the James River and Pipestem Creek; reported common by local fishermen.
4. **Catostomus teres** Mitchill. *White Sucker; Small-scale Sucker.* Taken at both *stations*; very abundant at La Moure.
5. **Moxostoma macrolepidotum duquesnei** (Le Sueur). *Redhorse; White Sucker.* Taken at Jamestown, but rare.
6. **Campostoma anomalum** (Rafinesque). *Stone-lugger; Donghbelly.* Taken at Jamestown in abundance. This is the first station where this species was taken in large numbers.
7. **Pimephales notatus** (Rafinesque). La Moure and Jamestown. Many small specimens were taken at the first station, less common at the second.
8. **Pimephales promelas** (Rafinesque). Common at La Moure.

9. **Hybognathus nuchalis** (Agassiz). Jamestown, very rare. Seldom met with in this region. Specimens of medium size and in good color.
10. **Notropis megalops** (Rafinesque). La Moure and Jamestown; abundant.
11. **Notropis deliciosus** (Girard). La Moure; Jamestown. Rare at the former, quite common at the latter place. Many specimens infested with a flat white worm, which inhabits the abdominal cavity. These parasites were from 30 to 50 mm. long and about 2 mm. wide.
12. **Notropis cayuga** Meek. James River at Jamestown, 16 specimens, very large.
13. **Hybopsis kentuckiensis** (Rafinesque). *River Chub.* Common in James River and Pipestem Creek.
14. **Semotilus atromaculatus** (Rafinesque). *Creek Chub.* James River and Pipestem Creek. Not common nor large in size.
15. **Rhinichthys atronasus** (Mitchill). *Black-nosed Dace.* Common at La Moure and Jamestown; prefers cool and swift water.
16. **Lucius lucius** (Linnæus). *Pickerel; Pike.* Jamestown, abundant in the mill-pond; very fine specimens taken with hook and line.
17. **Etheostoma nigrum** Rafinesque. *Johnny Darter.* Jamestown; more than a hundred specimens taken from one ripple. Color very dark; V-shaped markings on the side very distinct.
18. **Etheostoma aspro** (Cope & Jordan). *Black-sided Darter.* A single specimen taken at Jamestown.
19. **Etheostoma iowæ** Jordan & Meek. Jamestown, 50 specimens; more abundant than *E. nigrum.*

Eleven examples give the following measurements:

Length.	Head.	Depth.	Lat. line.	Dorsal.	Anal.
mm.	*mm.*	*mm.*			
50	14	9	55	IX-10	II-8
52	14	10	53	X-11	II-7
50	14	9	53	X- 9	II-7
50	14	10	55	IX-10	II-8
47	13	9	54	IX-11	II-7
53	14	11	50	X-10	II-7
51	14	10	55	IX-11	II-7
46	13	11	55	IX-10	II-8
46	13	9	53	IX-10	II-7
46	13	9	55	IX-11	II-7
47	13	9	55	IX-10	II-7

Scales with pores in lateral line from 25 to 28, very variable.

20. **Perca flavescens** (Mitchill). *Yellow Perch; Ring Perch.* Five small specimens taken at Jamestown; reported common in deep water.

THE RED RIVER OF THE NORTH.

The Red River of the North, in the United States, consists of the upper and middle course of the southern inlet of Lake Winnipeg. It flows in a direction contrary to that of the streams on either side of it, and apparently makes its way against rising ground. The Red River lies wholly within drift territory, but, unlike most other rivers, flows against or opposite to the course of the glacier. This is not the case with many of its tributaries, however, that seem naturally to take a southern course until in the immediate valley or flood-plain of the Red River, when they turn sharply and flow toward the larger stream. The broad valley of the Red River of the North is very level, and widens

gradually to the northward. The soil is a deposit of fine sand and clay, the surface of which is generally free from bowlders. The narrow valley that the river now occupies has been cut down by erosion from 50 to 75 feet below the surrounding country. Concerning the formation of the valley or flood-plain, there is abundant evidence everywhere to show that it has been the bed of a great inland lake.

Moorhead, Minn., July 25.—Fished in the Red River of the North, north of that city. The river here is 75 feet wide and very crooked and muddy. It looks like a great drainage ditch, filled with foul, muddy water. The color of the water is very light, owing to the great quantities of very fine light clay held in suspension. The bed of the river is of clay, very uneven, and worn in parallel grooves. The banks are of mud, which, along the water's edge, is soft and deep. The immediate banks of the river are about 10 feet above the water and are covered with a natural growth of ash, elm, oak, box-elder, and maple. There appears to be little or no vegetable life in the stream, not even growing in the water's edge. The great amount of sediment of fine clay in the water appears to be detrimental to both animal and vegetable life, and especially to the latter. No water insects or larvæ were found. A few crawfish were taken, and one empty clam shell was observed. The river was seined with a 45-foot seine, which brought to the shore sufficient numbers of a few specimens of fishes to indicate that they were reasonably abundant. Moon-eyes, or skipjacks, were in greatest abundance; goggle-eyes and suckers were common; two species of catfish were reported numerous by local fishermen; one large ling (*Lota lota maculosa*) was taken; minnows and darters were rare; *Hybopsis storerianus* was common and very large.

Grand Forks, N. Dak., August 9.—The Red River was pretty thoroughly seined at a point 2 miles above the town. The water was not so deep as where it was examined at Moorhead, Minn. The general character of the river remains about the same. The shore lines and flood plains are of the same fine, adhesive mud, and the bottom is of the same tough bowlder clay. The water here has not only cut a ditch through the loose fine material of the lake sediment, but it has worn several feet into the tough clay at the bottom. There is no vegetation in the muddy water, but the flood-plain and the banks seem well adapted to the growth of trees, which cover many miles with a growth of elder, basswood, ironwood, and oak. At the city of Grand Forks, 2 miles below the point where the river was examined, the Red River of the North is joined by the Red Lake River from the northeast. The country between these rivers, for several miles from their union, is of river deposit, and has been covered by a dense growth of large deciduous trees. The water of the river is usually very muddy. The depth of the water is pretty even throughout the summer, but in the spring the water frequently rises 30 feet or more on account of ice gorges.

There are several local fishermen here, who fish principally with trot

lines. Catfish, suckers, moon-eyes, and wall-eyed pike are the most common varieties. The catfish grow to a large size. Both genera, *Ameiurus* and *Ictalurus*, are common. One small *Etheostoma* was taken. Two large turtles (too large to be preserved and hence unidentified) were captured with the seine.

Otter Tail River, Breckenridge, Minn., July 23.—This is one of the largest eastern tributaries of the Red River of the North. It rises in a county of the same name, about 50 miles east of Breckenridge. At Breckenridge it joins the Boise de Soux to form the Red River. The Boise de Soux is a continuation in the valley of the Red River, but the Otter Tail is by far the larger stream. The Otter Tail River is a stream 75 to 90 feet wide and 4 to 6 feet deep, though in many places it is much deeper. The current is swift (4 miles per hour), and there is always a good supply of water, since the river is the outlet of several lakes, the largest of which, Otter Tail Lake, has an area of 20 or 30 square miles. The water is turbid and never clear, even during low water, since the sediment carried is a very fine light-colored clay.

The stream rises in a very level or basin-like drift area, flows through drift soil its entire length, nowhere reaching hard bedrock. The course of the stream is exceedingly tortuous. The bed is of smooth, hard clay in the swifter portions, with sand and gravel in other places. The deeper portions of the stream and the shores and eddies are of mud, covered with sand and gravel a few inches deep. The bed and the channel change slightly with every high rise of water. The banks will average 20 feet in height and are steep and but little eroded. The country is level, and the stream has simply eroded the drift to that depth. The drift deposit here is comparatively free from bowlders. Water vegetation is very scant, although mints and cress grow in shallow water along the shores. The banks are lined with small trees and shrubs; willows and box-elders grow to the water's edge.

The stream was fished northeast of the town of Breckenridge, about a mile above the Great Northern Railroad bridge. The chief difficulties in collecting are the swift current and steep banks. The 15 and 45 foot seines were used, but fish life was not found to be abundant. Among the food-fishes taken and those reported most common were suckers (*Moxostoma macrolepidotum duquesnei*), rock bass (*Ambloplites rupestris*), and two varieties of catfish (*Ameiurus nebulosus* and *Ictalurus punctatus*). One specimen of the former weighing about 5 pounds was taken. Temperature of water, 79°.

Cheyenne River, Lisbon, N. Dak., July 26.—The Cheyenne is the largest western tributary of the Red River, and rises about 45 miles southwest of Devil Lake in Wells County, near the source of the James or Dakota River. The two streams flow parallel with each other, about 40 or 50 miles apart, one on either side of a low divide. For 180 miles the Cheyenne flows in a southeasterly direction. At Scovill, 10 miles below Lisbon, the course suddenly changes to northeasterly and con-

tinues in that direction for about 50 miles, until it joins the Red River of the North. The country around Lisbon is drift, somewhat eroded and broken. The stream here is about 35 feet deep; its bed is sand and gravel. In the ponds or quiet water the bed is of fine sand, but at the ripples it is of stones and coarse gravel. The stream is very beautiful, and is almost one succession of ripples of clear water. There was but little vegetation in the water. A few pond weeds were observed in the more quiet waters, and the larger stones in the ripples were covered with a short crisp moss. Fishes of several species were numerous, and hundreds were taken at a single haul of the 15-foot seine; minnows and darters were numerous. The stream was well stocked with such food-fishes as pickerel, suckers, catfish, and rock bass. The writer was assured that at the mill-pond 5 miles below Lisbon hundreds of pounds of fish could be taken with a hook, and that the fish frequently stopped the mill by getting into the wheel. This statement was made at other places. The stream is well shaded with trees that grow to the very edge of the water, overhanging and effectually protecting it from the sun in many places.

Valley City, N. Dak., July 28.—Although this point is 40 miles nearer the source than Lisbon, the stream is apparently much larger, being deeper and broader. The river flows through a very beautiful valley, a mile wide, that is densely covered in many places with a growth of small timber. The hills on either side of this valley rise to a height of 100 to 150 feet, and in places are quite abrupt. This water is exceptionally clear for a prairie stream, flowing for much of the distance over clean sand and gravel. It is from 60 to 70 feet wide, and will average at least 4 feet in depth. The banks are steep, and from 10 to 15 feet high from the water to the flood-plain. No shallows or ripples were found, but a ford or crossing is located 7 miles below Valley City. The river was seined just below the milldam, where fish were found in greater abundance than where it was examined at Lisbon. The 30-foot seine was used, and possibly a thousand specimens were taken at every draw. Among the more abundant species were *Pimephales notatus*, *Notropis megalops*, *Catostomus teres*, *Moxostoma macrolepidotum duquesnei*, *Percopsis guttatus*, and *Etheostoma aspro.*

This stream is an excellent one for fish on account of its natural physical features and the abundance of food. Crawfish were abundant. The long grass and other vegetation that grew in tufts and patches were filled with crustaceans and insect larvæ. No contamination of the waters was observed or reported. Two high dams unprovided with fishways were the only bad features of the stream observed.

Maple River, Mapleton, N. Dak., July 29.—This is only a small creek, tributary to the Cheyenne River and lying wholly within or about the western edge of the Red River Valley. The stream flows throughout most of its course parallel with Cheyenne River. The upper course flows south, then, making a sharp turn to the northeast, flows toward

the Red River until within a few miles of that stream, where it joins the Cheyenne. The stream has cut for itself only a narrow, shallow valley, and winds leisurely along through the level country with almost an imperceptible current. At the place examined the stream is about 20 feet wide and 2½ or 3 feet deep. The bed is of mud, with but little sand or gravel, covered in many places with a thick growth of weeds, grasses, and rushes. Two species of ditch-weed are common. The banks are almost devoid of vegetation; an occasional willow or box-elder is all that can be found. The stream was thoroughly seined at the railroad bridge, but fish life was not abundant. Crawfish, leeches, small crustaceans, water-snails, and clams were all well represented. A very large species of *Planorbis* was particularly abundant. The water was warm, 78°.

Buffalo River, Hawley, Minn., August 1.—This is a small stream about 50 miles long, rising in the White Earth Indian Reservation, Minn. It flows southwesterly for about half its length, and then turning toward the northwest joins the Red River of the North at Georgetown. Hawley is about 25 miles from the mouth of the stream. At this point the stream is 20 feet wide and 2 feet in average depth. The water is clear and the current rapid. The bed is of sand and small gravel, and almost devoid of vegetation. The low banks are lined with small timber and underbrush. The stream is well stocked with fish, but is obstructed by several dams which prevent the running of the fish. The stream contained rock bass, pickerel, catfish, minnows, and darters. A great many clams were seen, and in several places the bed of the stream was almost covered with these animals. Crawfish were rare. Temperature of the water, 70.5°.

Goose River, Hillsboro, N. Dak., August 4.—Temperature of the water, 70°; of the air, 73°. This is one of the small western tributaries of the Red River of the North, rising in the elevation between Devil Lake and the Red River. The course is southeast to its junction with the Red, 12 miles from where it was examined. This stream has eroded a very deep, wide valley and the water flows at the rate of 4 miles per hour. The stream averages 20 feet in width, but has a flood-plain nearly half a mile wide. The depth varies from 2 to 5 feet, and the water is cloudy. Algæ, water weeds, and grass grow in the stream at the ripples. The banks and flood-plain are covered with trees which form a forest of maple, box-elder, and willow. These trees have fallen into the river until the channel is pretty well filled with brush and logs. The stream has evidently cut through the lake deposit and drift, since the banks and bed, in places, are formed of a tough blue clay and at intervals fragments of slate have accumulated.

The stream was a difficult one in which to make collections, but *Catostomus teres*, *Lucius lucius*, *Moxostoma macrolepidotum duquesnii*, and a few other varieties were common. Many of the fishes, especially of the genus *Notropis*, were profusely covered with immature parasitic

trematodea appearing as black dots about the size of a pinhead. Others were affected by what seemed to be a small white worm encysted just under the skin.

Mouse River, Minot, N. Dak., August 6.—This station is located just where the ground begins to rise into the foothills of the mountains. The stream flows through a valley one-half to three-fourths of a mile wide, lined on either side by eroded and rounded hills from 50 to 75 feet high. The stream will average 10 yards in width and from 2 to 2½ feet in depth. The bed is of drift stones, coarse gravel, and mud, the latter always supporting a growth of vegetation, of mints, grasses, or rushes. The stream is a good one for fish; while the water is not clear, it has only enough sediment to cause it to look cloudy in the deeper places. There are numerous ripples in the stream over which the water runs at the rate of 3½ to 4 miles per hour. Several species of fishes are common. Black suckers are reported as being especially abundant during the spring and fall rises. Crawfish were taken by hundreds at almost every haul of the seine; a few clam shells were also observed. Univalves and the small crustaceans were rare, as were also algæ and other vegetation living entirely in the water.

English Cooley, Grand Forks, N. Dak., August 10.—The English Cooley is a small drain 2 miles west of Grand Forks. During a greater part of the year it has no current whatever. The banks are low and the water is filled with vegetation. It contained a few species of fishes, crawfish, and water insects. The predominating fishes are *Catostomus teres* and *Pimephales notatus*, both covered with parasites. The mud in the bottom of the stream was deep and the water at the bottom very clear.

Red Lake River, Grand Forks, N. Dak., August 12.—This is the largest eastern tributary of the Red River of the North, and is different in many respects from the other tributaries of that stream. It drains Red Lake, a double lake 600 square miles in area, lying in the northern part of Red Lake Indian Reservation. The general course of the river is west, although it makes two great curves. Unlike most other streams of this region, this river starts toward the northwest and continues thus until more than half the distance from the lake to the Red River of the North is covered, then it turns suddenly toward the south and southwest and then again takes a northwesterly direction, which it pursues until it joins the Red River of the North. Another stream, Clearwater River, rising south of Red Lake, follows the same general direction as Red Lake River. Red Lake River is nearly as wide as the Red River of the North, but much more shallow. It is very rapid and the waters are of a reddish tinge. This difference in the color in the waters of these two rivers is very marked, especially when the Red Lake River mixes its waters with the whiter waters of the Red River of the North.

The bed of the river is of clean sand, a feature with which we do

not meet in any other river of this region, and since the lower course of the stream is through drift, this sand must come from the middle or upper course. Great quantities of sand are brought down and passed into the Red River of the North, from which stream it is dredged up and used for building purposes. The water of Red Lake River is much clearer and cooler than that of the Red River of the North. The water supply of the cities of Grand Forks, N. Dak., and Crookston, Minn., come from this stream, and water taken from the hydrants of these cities is clear and apparently of good quality.

The river was seined 2 miles from its mouth. At this point it averages only about 4 feet in depth, but with a current of 4½ to 5 miles per hour. The bed of the stream here is of hard bowlder clay, and is kept swept clean by the force of the current. The water was so swift that the seine was handled with difficulty. The bed of the stream was almost clear of bowlders, but offered a number of other obstructions in the way of snags, logs, and brush.

The fishes most common were gold-eyes (*Hiodon tergisus*), channel cat (*Ictalurus punctatus*), suckers (*Moxostoma macrolepidotum duquesnii*), and pickerel (*Lucius lucius*). A few clam shells were observed and a few crawfish taken, but animal life was by no means abundant, and no plants were observed growing in the water. The low banks of the river were covered with elm, basswood, cottonwood, and box-elder.

Crookston, Minn., August 20.—Crookston is about 18 miles from the mouth of Red Lake River, and is located at a place where the ground commences to rise toward the east. The river is dammed at this place, and hence this is an excellent point for making collections. It was fished below the dam, where it is possibly 75 or 85 feet wide, with a depth of from 4 to 10 feet. The current is very rapid, but the bed is smooth and the shore on the north side low and hence convenient for landing the seine. In the deepest places the bed is of smooth, hard clay or rock. This is the best point found for collecting. Suckers and gold-eyes were taken in large numbers, while pickerel and pike perch were also common. Catfish and ling were abundant, but only small specimens of the latter were taken.

Tongue River, Bathgate, N. Dak., August 15.—This is a small southern tributary of the Pembina River, rising in a low drift elevation that borders a section of the Red River of the North on the west. It is about 50 miles long; at the place examined, 10 miles from its mouth, it was 25 feet wide and 2 or 3 feet deep. The water was very sluggish and full of lower-life forms of both animals and plants. The bed of the stream is of mud (with a few inches of fine white sand in places) and gives rise to a great quantity of pond vegetation. *Chara*, pondweeds, etc., grew so abundantly that it was difficult wading and almost impossible to drag the bottom of the stream with a seine. Pickerel and suckers were about the only common species of fish.

Pembina River, Neche, N. Dak., August 16.—This is one of the large

northern tributaries of the Red River of the North. Much of its course lies near the forty-ninth parallel, which it crosses several times. Neche is 15 miles from the mouth of the river, and lies in a level country, a part of the ancient lake bed. There is little to indicate that this country has been submerged, other than its flatness, presence of gravel, shells, etc., but near Pembina there is proof not only that the level country has been inundated, but that the water has stood several feet above the level. I refer to the Pembina Mountain, an elevation many feet in height near the mouth of the river, bearing on its sides in unmistakable characters the writing of the waves of the ancient Lake Agassiz.

The river at the time it was examined was somewhat swollen from recent rains, and the water was muddy and very swift; the bed of the stream was composed of clay, firmer and harder than the material which composes the steep banks. This material was so loose that at places large quantities of it had slid into the stream. The stream was well stocked with fishes, but limited in variety; several pickerel and a number of suckers weighing from 1½ to 3 pounds were taken; a few darters and minnows were also found.

Park River, Grafton, N. Dak., August 16.—This is a foul, sluggish river, rising in the western part of Walsh County, just beyond the flood-plain or in the low hills bordering the old lake basin on the west, and flowing almost east to the Red River of the North. The town of Grafton is about 20 miles from the mouth of the stream and 40 miles from its source. The river here is about 15 feet wide and 1½ to 3 feet deep. The banks are low, composed of fine sand and clay and other sedimentary deposit. The bed of the stream is of the same material, and overgrown with rank water vegetation. The low flood-plain is covered with a growth of forest trees—ash, elm, basswood, and oak being the most common. Wild gooseberries grow in great abundance among the trees. The stream contains only a few varieties of fishes, and these are poorly represented. The water is cloudy and brackish; from this cause the river was called by the early settlers Salt River.

Forest River, Minto, N. Dak., August 17.—Forest River is a very beautiful little stream of quite a different character from the other streams of this region, and though of nearly the same size and flowing in the same direction as the one last described it differs from it in many respects. The water is clear and sweet, the current swift. The stream is 15 or 18 feet wide, and will possibly average 2 feet in depth, although many places are much deeper. The river was seined just below a low dam at the crossing of the Great Northern Railroad. Although at this place the bed of the stream is mostly composed of mud, the waters of the upper course flow almost entirely over beds of clean sand and gravel, the water at such places being devoid of vegetation. The stream is fed by springs, and the water (whose temperature was 67°) is from 4 to 6 degrees colder than any other stream of this region. The

flood-plain is from a half to three-quarters of a mile wide, and is overgrown with a heavy growth of large timber—ash, elm, and oak—with thick underbrush of hazel and wild cherry. The stream is well filled with fishes rich in variety; hundreds of specimens were taken at every haul of the seine. The most plentiful are chubs, pickerel, minnows, and suckers. *Notropis hudsonius* was particularly numerous and very large in size; a number of fine darters were also taken.

Turtle River, Manvel, N. Dak., August 18.—This is a small grassy stream that flows into Morse Slough, a bayou of the Red River of the North. The banks and bed of the stream are of soft mud covered with leaves and grasses. But few fishes were taken, and these were covered with parasites.

Detroit Lake, Detroit City, Minn., August 21.—This is one of the most beautiful lakes in northwestern Minnesota. It has an area of 5 or 6 square miles and the water is deep and clear. It is surrounded by high wooded banks of drift deposit, varying greatly in structure, which gives the lake an exceedingly irregular outline. It is connected by canals (made along natural waterways) with Lakes Sally and Melissa, these two lakes lying more than 6 feet below the surface of Detroit Lake. All, especially Detroit Lake, are well stocked with the game-fishes common to this section of the country. Bass, pickerel, wall-eyed pike, pike perch, and ring perch are abundant, and on this account the lake is fast becoming a favorite resort for the angler and tourist.

Minnewaukan, or Devil Lake, August 5.—This is an isolated body of water lying just beyond the divide that separates the Red River system from the Devil Lake region. It occupies the lowest part of a large basin 50 miles long by 30 miles broad, and being in a district where there is but little rainfall, and receiving no large tributaries, it is rapidly drying up. About the lake, from 1½ to 2½ miles from the present shore line, the country is an old lake bed which the vegetation has not yet covered, and the shells, pebbles, and sands of the lake are lying undisturbed and bare. North and east of the lake a considerable expanse of country presents the unmistakable signs of having been recently submerged, while on the higher rises of ground forest trees grow. These elevations were islands, and plainly show the old water-lines. On the south hills rise to the height of 250 to 400 feet, and are heavily timbered.

The lake is not deep, soundings showing from 22 to 35 feet. There is a difference in the temperature of the water between the bottom and top of the lake of about 2 degrees, the top being 79 and the bottom 77. To the northeast the land is low, indicating an active outlet for the lake when the depth of water was much greater than at present. I was informed by good authority that a few years ago the lake was well stocked with fishes, pickerel being by far the most abundant species. It is also said that these fish were taken with hook and line during the winter season in great numbers, piled up, and sold literally by the cord. Now a pick-

erel is seldom seen, and the question naturally arises, What has become of the fish? If the fish had been attacked by any disease that would materially reduce the numbers dead fish would have been seen along the shores and in the water, but none has ever been reported. It is well known that the water of this lake is quite brackish, and it has been thought that the rapid evaporation of the water had so increased the percentage of mineral matter as to make it detrimental to fish life. The stickleback (*Eucalia inconstans*), however, not only lives, but increases in a manner quite marvelous. Almost every haul of the seine would land hundreds of these small fish, the greater number of which were very large and almost jet-black in color. In the long grass and shore waters larvæ and small crustaceans were very rare. It may be that this stickleback, which eats the eggs of other species, has by this habit brought about the great depletion of fish in these waters.

ANNOTATED LIST OF FISHES OF THE RED RIVER OF THE NORTH AND ITS TRIBUTARIES.

1. **Ammocœtes branchialis** (Linnæus). *Mud Lamprey; Brook Lamprey.* Cheyenne River at Lisbon, 3 specimens; Red Lake River at Grand Forks, 2; Red Lake River at Crookston, 1. Although few of these parasites were taken, a sufficient number of marks were found on fish to indicate that they were numerous. Species of *Catostomus* and *Moxostoma* appear to suffer most from this animal; and, contrary to popular belief, it is seldom taken in sluggish waters, but in clear, swift streams. In the Cheyenne River a lamprey and its host were taken, the latter bearing marking that would indicate that it had been the victim of several of these creatures.
2. **Lepisosteus osseus** (Linnæus). *Gar Pike.* Otter Tail River at Breckenridge, 1 large specimen. Reported abundant in certain deep places in the river.
3. **Ameiurus nebulosus** (Le Sueur). *Bullhead; Catfish.* Otter Tail River at Breckenridge, 3 specimens; Red River of the North at Moorhead, rare; Cheyenne River at Lisbon, 5; Cheyenne River at Valley City, 4; Maple River at Mapleton, abundant; Buffalo River at Hawley, common; Goose River at Hillsboro, common; Forest River at Minto, 4. This species was reported abundant at almost every place where inquiry was made, especially at stations on the Red River of the North, though comparatively few specimens were observed in the quiet waters and lagoons above the dam in Buffalo River at Hawley. A large specimen weighing about 15 pounds was taken from the Otter Tail River at Breckenridge.
4. **Ameiurus melas** (Rafinesque). Cheyenne River at Valley City, 4 specimens; Maple River at Mapleton, common; Goose River at Hillsboro, 12. The last-named station was the only locality where this species was common. From this stream 12 adults and a large number of young were taken.
5. **Noturus gyrinus** (Mitchill). Maple River at Mapleton, 3 specimens; Cheyenne River at Valley City, 10; Goose River at Hillsboro, 55; Red River of the North at Grand Forks, 4. These specimens were nearly all small; those from Goose River averaged 2¾ inches in length.
6. **Ictalurus punctatus** (Rafinesque). *Blue Cat; Channel Cat.* Otter Tail River at Breckenridge, 1 specimen; Red River of the North at Moorhead, common; Red River of the North at Grand Forks, 4; Red Lake River at Grand Forks, common; Red Lake River at Crookston, 5.
7. **Catostomus teres** (Mitchill). *Black Sucker; Common Sucker; Fine-scaled Sucker.* Cheyenne River at Lisbon, abundant; Cheyenne River at Valley City,

abundant; Maple River at Mapleton, 6; Buffalo River at Hawley, abundant; Goose River at Hillsboro, abundant; Mouse River at Minot, plentiful; English Cooley at Grand Forks, common; Pembina River at Neche, rare; Park River at Grafton, 7. This species was taken from almost every tributary of the Red River of the North, but was not found in the main stream. I was told by the miller at Hawley that great numbers of the young of this species would come almost every day and fasten (suck) themselves onto the boards of the dam, where they would remain for several hours.

8. **Moxostoma macrolepidotum duquesnii** (Le Sueur). *Redhorse; White Sucker.* Red River of the North at Moorhead, abundant; Cheyenne River at Lisbon, common; Cheyenne River at Valley City, abundant; Buffalo River at Hawley, 10 specimens; Red River of the North at Grand Forks, rare; Red Lake River at Grand Forks, common; Park River at Grafton, rare; Red Lake River at Crookston, abundant. This species prefers clear water. It is rare in the Red River of the North, but common in Red Lake River; even near its mouth, at Crookston, it is very abundant, the seine landing 8 or 10 large specimens at a haul.

9. **Notropis megalops** (Rafinesque). *Common Shiner.* Otter Tail River at Breckenridge, abundant; Red River of the North at Moorhead, rare; Cheyenne River at Lisbon, plentiful; Cheyenne River at Valley City, common; Maple River at Mapleton, abundant; Buffalo River at Hawley, abundant; Goose River at Hillsboro, plentiful; English Cooley at Grand Forks, not abundant; Pembina River at Neche, common; Forest River at Minot, common; Red Lake River at Crookston, abundant. This species appears to adapt itself to all conditions of temperature, water, food supply, etc., since it is one of the most widely distributed species of the Cyprinidæ, and thrives equally well in all parts of the great range over which it is distributed.

10. **Notropis deliciosus** (Girard). Otter Tail River at Breckenridge, 28 specimens; Cheyenne River at Valley City, common; Mouse River at Minot, 15; Pembina River at Neche, abundant; Forest River at Lisbon, common; Red Lake River at Crookston, common. These specimens, when compared with others from the Mississippi Valley, show no very marked modifications, except possibly the bodies are somewhat stouter. Largest specimens average 2 inches long.

11. **Notropis dilectus** (Girard). Otter Tail River at Breckenridge, 1 specimen; Cheyenne River at Lisbon and Valley City, common; Buffalo River at Hawley, rare; Red River of the North at Grand Forks, rare; Red Lake River at Crookston, 2. Specimens from Red Lake River were in the best color, and hence more like individuals of this species found in the Mississippi Valley. Those from the Red River of the North were very light, almost translucent. Specimens from the Cheyenne were in good color, the head, sides below lateral line, dorsal, caudal, and pectoral washed with red.

12. **Notropis atherinoides** Rafinesque. Pembina River at Neche, 1 specimen; Red Lake River at Crookston, 25. Specimens from Crookston average 2¼ inches in length. This species was taken in abundance by Dr. Eigenmann farther north.

13. **Notropis whipplii** (Girard). Cheyenne River at Lisbon, common. Although home of this species is much farther south, it varies as little in color and markings as any other fish of this region, remaining almost true to the type.

14. **Notropis cayuga** Meek. Buffalo River at Hawley, rare; Maple River at Mapleton, 8 specimens; Cheyenne River at Lisbon, 5; Cheyenne River at Valley City, 6. Specimens in this valley average only about 1½ inches long. The colors are good, the lateral line quite black, just wide enough to cover one row of scales, and quite distinct over opercle and around snout; no vertebral stripe; scales in lateral line 36; these have a peculiar notched

appearance on account of mucous pores. Specimens from Valley City are exceedingly large and fine in color, length 2 inches. Many of the females contained ripe eggs.

15. **Notropis jejunus** (Forbes). Pembina River at Neche, 40 specimens; Red River of the North at Moorhead, 9; Red River of the North at Grand Forks, 6; Forest River at Minto, common; Red Lake River at Crookston, 11. This is a very handsome minnow; body and caudal peduncle deep, with a broad straight lateral stripe of silvery pigment, edged with a dark line above.
16. **Notropis hudsonius** (Dewitt Clinton). Otter Tail River at Breckenridge, 1 specimen; Red River of the North at Moorhead, 5; Cheyenne River at Valley City, 1; Mouse River at Minot, common; Red River of the North at Grand Forks, common; Red Lake River at Grand Forks, rare; Park River at Grafton, 1; Red Lake River at Crookston, rare.
17. **Pimephales notatus** (Rafinesque). Otter Tail River at Breckenridge, rare; Cheyenne River at Lisbon, common; Cheyenne River at Valley City, plentiful; Goose River at Hillsboro, rare; Buffalo River at Hawley, 2; Mouse River at Minot, rare. This species was not taken in as great numbers as *P. promelas* and is possibly not as generally distributed throughout this valley, but is found in purer water and in clearer streams.
18. **Pimephales promelas** Rafinesque. Maple River at Mapleton, 5 specimens; Buffalo River at Hawley, rare; Goose River at Hillsboro, abundant; Cheyenne River at Valley City, common; Forest River at Minot, common. Specimens from Goose River have a small white parasite encysted just under the skin.
19. **Rhinichthys cataractæ dulcis** (Girard). Cheyenne River at Lisbon, abundant; Cheyenne River at Valley City, 24 specimens; Maple River at Mapleton, common; Buffalo River at Hawley, 75; Pembina River at Neche, 3; Forest River at Minot, common; Red Lake River at Crookston, 1. This species thrives better, apparently, farther north than in the localities here given; specimens from Red Lake and Maple rivers were very small. Specimens taken farther north by Dr. Eigenmann were much larger. Our finest specimens were taken from Cheyenne River; at Lisbon, N. Dak., these specimens averaged 55 mm. in length, 11 mm. in depth, and were very plump and round. Color, very dark above, with small round dark spots on sides, from lateral line to belly; caudal spot distinct, with part of caudal peduncle black. Taken only in the swift ripples.
20. **Semotilus atromaculatus** (Mitchill). Maple River at Mapleton, rare; Buffalo River at Hawley, 5 specimens; Pembina River at Neche, 10; Forest River at Minot, 14. Specimens unusually small.
21. **Hybopsis kentuckiensis** (Rafinesque). *River Chub.* Otter Tail River at Breckenridge, common; Cheyenne River at Lisbon, 7 specimens; Cheyenne River at Valley City, rare; Buffalo River at Hawley, 5; Maple River at Mapleton, rare; Forest River at Minot, 2; Red Lake River at Crookston, 14. Not an abundant species in these waters—more rare than the preceding.
22. **Hybopsis storerianus** (Kirtland). Otter Tail River at Breckenridge, 3 specimens; Red River of the North at Moorhead, abundant; Red River of the North at Grand Forks, common; Red Lake River at Grand Forks, 3; Red Lake River at Crookston, 10. Found only in large streams. It reaches a length of 4 inches and is the largest minnow found in this region.
23. **Notemigonus crysoleucas** (Mitchill). Cheyenne River at Lisbon, rare. Rare even in the northern part of the Mississippi Basin.
24. **Hiodon tergisus** Le Sueur. *Moon-eye.* Red River of the North at Moorhead, common; Red River of the North at Grand Forks, abundant; Red Lake River at Crookston, common. Common throughout the basin of the Red River of the North and Lake Winnipeg.

25. **Hiodon alosoides** (Rafinesque). *Moon-eye.* Red River of the North at Moorhead and Grand Forks, rare; Red Lake River at Crookston, rare. This species is not so common as *H. tergisus.*

26. **Percopsis guttatus** Agassiz. *Trout Perch.* Otter Tail River at Breckenridge, 1 specimen; Red River of the North at Moorhead, common; Cheyenne River at Lisbon, 2; Cheyenne River at Valley City, abundant; Goose River at Hillsboro, common; Pembina River at Neche, 4; Red Lake River at Crookston, common. Eight specimens of this species from Cheyenne River, Valley City, measure as follows:

Length.	Head.	Depth.	Eye.	Lat. line.	Dorsal.	Anal.
Mm.	*Mm.*	*Mm.*	*Mm.*			
85	25	15	5	50	10	6
75	23	15	5	52	11	6
73	23	14	5	51	11	7
73	23	15	5	50	10	6
78	23	15	5	53	11	6
76	23	14	5	51	11	7
73	22	14	5	52	11	7
73	22	14	5	52	11	6

The fishes from this stream were in fine color. Light olive on back, shading to lighter on sides, and nearly pure white on the belly; back mottled, with mingled light and dark scales; cheeks and opercles shaded with very small dark dots; dorsal and anal sparingly clotted with black.

27. **Fundulus diaphanus** (Le Sueur). Cheyenne River at Valley City, 2 very small specimens.

28. **Lucius lucius** (Linnæus). *Pickerel; Pike.* Otter Tail River at Breckenridge, 4 specimens; Cheyenne River at Valley City, common; Goose River at Hillsboro, common; Mouse River at Minot, 3; Park River at Grafton, abundant. Preeminently the food and game fish of this section of country. Reported abundant at nearly every station visited, though few were taken with the seine in some localities.

29. **Eucalia inconstans** (Kirtland). *Brook Stickleback.* Maple River at Mapleton, common; Mouse River at Minot, rare; Goose River at Hillsboro, 6 specimens; Red River of the North at Grand Forks, 1; English Cooley at Grand Forks, rare; Forest River at Minot, common; Red Lake River at Crookston, 2. A widely distributed species, quite as common north as south of the divide.

30. **Ambloplites rupestris** (Rafinesque). *Rock Bass; Goggle-eye.* Cheyenne River at Valley City, rare; Maple River at Mapleton, common; Red Lake River at Crookston, 5 specimens. Not rare nor confined to a limited area, but apparently grows more and more scarce as we proceed north. This is the only member of the *Centrarchidæ* found in these waters.

31. **Etheostoma nigrum** Rafinesque. *Johnny Darter.* Otter Tail River at Breckenridge, 2 specimens; Cheyenne River at Lisbon, 4; Cheyenne River at Valley City, 70; Maple River at Mapleton, common; Buffalo River at Hawley, 25; Goose River at Hillsboro, common; Mouse River at Minot, rare; Red Lake River at Crookston, not abundant. More specimens of this darter were taken than any other, and while it may not be more widely distributed than *E. aspro*, the latter is not so abundant in this region.

32. **Etheostoma aspro** (Cope & Jordan). *Black-sided Darter.* Otter Tail River at Breckenridge, 6 specimens; Red River of the North at Moorhead, rare; Cheyenne River at Lisbon, abundant; Cheyenne River at Valley City, abundant; Maple River at Mapleton, rare; Buffalo River at Hawley, 12; Goose River at Hillsboro, common; Mouse River at Minot, 4; Pembina River at Neche, rare; Forest River at Minot, 27; Park River at Grafton, 2; Red Lake River at Crookston, rare. At Minot we obtained 4 very large specimens

from a gravelly ripple where the water was not over 2 inches deep. The largest and finest specimens were taken from the Cheyenne River. One specimen from Valley City measured 3¼ inches long. Six from Lisbon measured as follows:

Length.	Head.	Depth.	Lat. line.	Dorsal.	Anal.
Mm.	*Mm.*	*Mm.*			
66	18	11	60	XIII-13	II, 10
64	18	12	60	XIII-14	II, 10
56	16	10	56	XII-14	II, 10
56	16	9	61	XIII-15	II, 9
58	16	10	58	XIV-14	II, 10
56	16	10	59	XV-14	II, 10

33. Etheostoma guntheri Eigenmann & Eigenmann. Red River of the North at Moorhead, 1 specimen; Red Lake River at Crookston, 6. Color, light olive, with nine or ten very distinct dark bands around the sides.

Measurements of 5 specimens from the Red Lake River are as follows:

Length.	Head.	Depth.	Dorsal.	Anal.	Lat. line.
Mm.	*Mm.*	*Mm.*			
33	9	6	XI-13	II, 12	48
34	9	6	X-12	II, 12	46
32	85	6	XI-12	II, 12	49
30	8	6	XI-13	II, 12	49
32	85	6	XI-13	II, 12	49

The large specimen from the Red River of the North differs very materially from the smaller in color, agreeing, however, in the marking on the anterior dorsal. The rays differ somewhat, and the scaling of the cheeks is not the same in that the specimen from the Red River of the North has cheeks covered with large scales. Length, 54 mm.; head, 13.5 mm.; depth, 85 mm.; D. IX–14; A. II–10; lateral line, 52.

34. Etheostoma iowæ Jordan & Meek. Cheyenne River at Valley City, 1 specimen; Cheyenne River at Lisbon, common; Red Lake River at Crookston, 5; Park River at Grafton, 6.

35. Stizostedion vitreum (Mitchill). *Wall-eye; Pike Perch.* Otter Tail River at Breckenridge, 1 specimen; Cheyenne River at Valley City, 6; Red River of the North at Grand Forks, rare; Red Lake River at Grand Forks, rare; Red Lake River at Crookston, 8. The last-named place is the only locality visited where the local fishermen report this species plentiful enough to furnish any considerable amount of food. From this stream it is taken with hook and line, principally from below the dam. I see no reason why the multitude of fine lakes throughout the State of Minnesota should not be stocked with this fine food-fish, since it could be done at comparatively small cost.

36. Perca flavescens (Mitchill). *Yellow Perch; Ringed Perch.* Forest River at Minot, common; Red Lake River at Crookston, common; Maple Creek at Mapleton, 5 specimens. Not frequently taken in the streams, but said to be found in nearly all the lakes of the State.

37. Aplodinotus grunniens (Rafinesque). *Fresh-water Drum; Grunter; Sheepshead.* Red Lake River at Crookston, 2 specimens. Not common; the fishermen seem to have but little knowledge of it.

38. Lota lota maculosa (Linnæus). *Lawyer; Ling.* Red River of the North at Moorhead, 1 specimen; Red Lake River at Crookston, 3. The one specimen from Moorhead was large, about 18 inches long, while those from Crookston were small. Occasionally taken on a "trot line" from the Red River, but not common.