HISTORY OF FISH AND FISHING IN THE UPPER MISSISSIPPI RIVER

By
HARRIET BELL CARLANDER

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INTRODUCTION

In December, 1943, a group of representatives from the conservation departments of the States of Minnesota, Wisconsin, Iowa, Missouri and Illinois, the Illinois Natural History Survey, and the U. S. Fish and Wildlife Service met in Dubuque, Iowa, and organized the Upper Mississippi River Conservation Committee (Smith, 1949). Each of the states named has responsibility for the management of the fish and wildlife resources of that portion of the river within its boundaries. The U. S. Fish and Wildlife Service shares in the responsibility for management of furbearers and migratory waterfowl. Because the river forms the boundary between states for most of its length, and fish and wildlife pay no attention to legal boundaries, proper management of these resources is furthered by cooperative action on both sides of the boundary. The U. M. R. C. C., as the Committee's name is often abbreviated, was established to aid in this cooperation and to sponsor scientific investigations on the fish and wildlife of the river. The Committee holds annual meetings and publishes an annual mimeographed report of progress. Three subcommittees, a Fish Technical Committee, a Game Technical Committee, and a Pollution Committee make recommendations for coordinated research investigations.

The present study of the historical background of the river in relation to the fish and fishing, both sport and commercial, was undertaken at the request of the Committee which provided traveling expenses for the writer.

For the purpose of this study, the Upper Mississippi River is defined as that part of the river which is between St. Paul, Minnesota, and Caruthersville, Missouri, a distance of 951 miles. For most of the distance it marks the boundary between Minnesota and Wisconsin, Wisconsin and Iowa, Iowa and Illinois, and Illinois and Missouri (Figure 1).

The sources of information about fishing on the Mississippi River are scattered in journals of travelers, histories of localities, reports of state conservation departments, records of exploring expeditions, newspapers, reports of government bureaus, and army records. The indexes of the publications are not always reliable guides, because often the references to fishing are very brief and, though important to a study such as the present one, were not considered of sufficient general interest to be catalogued.

The reasons for the widespread sources and the somewhat casual cataloguing of fishing information are not difficult to find. First of all,

the Mississippi traverses such a wide territory that it has affected many states and many people; thus, references to it are found in the official records of numerous states and the writings of a variety of individuals. Second, fishing on the Mississippi River has been subordinate to the commerce on the river. The colorful saga of the steamboat has eclipsed most other phases of river life. There are literally scores of books about steamboating, including memoirs of captains, histories of steamboat lines, and historical works which cover the whole period of steamboating (Merrick, 1909, Petersen, 1937, Fugina, 1945). Apparently, the Mississippi River fisherman was not as articulate as the river pilot.

Another problem, not limited to this particular study but characteristic of any historical analysis, is vividly portrayed in the following quotation, in which quite appropriately a river is used in an analogy to "the stream of history":

> *"If at different times we stand on the same spot on the bank of a river, we find that the stream has changed in amount of sediment, the number and character of its fish, its rate of flow, color, temperature, and so on. Yet if we had been standing on that spot continuously, we could not have said, 'Now, it is beginning to get colder,' or 'Now, it is beginning to flow faster.' It is only in retrospect and by comparison that we are conscious of these gradual changes, which begin at different times and merge imperceptibly one into the other."* (**Achorn,** 1934, p. 7).

BEGINNINGS

The oldest records of civilization found in the Mississippi Valley are the great mounds and fortifications built along the river and inland from it. These edifices were for protection and ceremonial purposes and were built by the earliest known race which inhabited the region. Some authorities have considered these mound-builders as unrelated to the Indians who were found by the white men when they came to North America (Calvin, 1893, p. 26). Others have shown that it is impossible to draw a line separating the "mound-building Indians" from the later Indians (Hurlbert, 1902, p. 41). These earliest inhabitants apparently did not build their villages immediately on the river banks, but settled farther inland where there was not so much danger from floods or from attacks by enemies coming from the river. The contents of the mounds, however, show that they did use the river as a source of food.

One of the earliest studies made of the ancient mounds in the Mississippi Valley was that of Squier and Davis in 1848. They reported shell ornaments from the mounds. Examples of *Unios* of the western rivers were found side by side with marine shells in the mounds. Sometimes the shells were complete, but often they had been carved or made into ornaments or spoons. Quarts of pearls were uncovered in the mounds, a few of them freshwater pearls, but most of them marine gems (Squier and Davis, 1848). The combination of shells from the rivers and from the ocean would indicate that there was intercourse between the tribes of the interior and those of the seacoast.

In the mounds of the "Ancient Buried City" near Wickliffe, Kentucky, shell spoons and fish hooks made of bones were found. Pottery made of clay containing ground shells was also discovered here and it is thought that the shells were used to strengthen the clay.

Dr. Duren J. H. Ward maintained that the mound-builders were not savages and cited their skill in weaving, basketry, and the making of artifacts. He said that they were expert at catching and spearing fish, and made the rivers contribute to the food supply of the tribe (Ward, 1903, p. 67).

The effigies of fish carved in stone which were found among the remains of the mounds are one more indication that fish were important to these prehistoric men (Calvin, 1893, p. 27).

Accumulations of freshwater shells along the Mississippi River and its tributaries were observed by Dr. C. A. White *in* 1868. He said that the general character of the shell-heaps resembled those found on the sea coast, but usually they were not as extensive as the sea coast ones. Among the most interesting shell-heaps which he found were those at Sabula and Bellevue, Iowa, on the Mississippi. Represented among the shells were fourteen species of *Unios* and one of *Paludina,* all of which were at that time (1868) still found in the Mississippi River. Also in the shell-heaps were found remains of catfishes, freshwater drum, snapping turtles, and soft-shelled turtles, as well as the bones of geese, buffaloes, and "common" deer (Rau, 1884, II, pp. 241-242). Both at Sabula and Bellevue, Dr. White found small pits in the ground which showed evidences of fire. The pits were filled with shells and bones. Evidently, the earth had been heated by building a fire in the pits, then the mollusks and other food were placed in the pits, covered and allowed to cook by the retained heat. The heaps were older than the coming of the white man, since no articles of civilized manufacture were found in them. Oaks and elm trees growing on top of the heaps were at least two hundred years old.

The Indians of the historic period also used the river as a source of food. Most of the references to Indian fishing methods are found in the journals of travelers to the western country. A valuable account of fishing methods carried on by a Canadian tribe related to the Chippewa and, therefore, probably typical of all the northern interior tribes, is contained in John Long's *Journal,* kept from 1768 to 1782 (Long, 1904). Long told how the Indians, fishing through the ice with nets, caught "18,000 weight" of fish and hung them by their tails across sticks to freeze. At one time, while traveling with the Indians, Long killed a hare, made fish hooks of the thigh bones, and baited the hooks with the flesh of the hare. The lines were made of the bark of a willow tree cut into strips and twisted together. Enough fish were caught with this tackle to supply the immediate needs of the Indians and for provisions for the rest of their journey. In a Chippewa vocabulary given in Long's book, there are words for trout, pike, pickerel, whitefish, fish, carp, and "net for fishing." Long wrote that in summer *"the fishers go up the lakes as well as rivers and are generally success-fur* (Long, 1904, pp. 261-265).

When Hernando De Soto explored the southern part of the Mississippi, he found the Indians fishing with nets for the catfish and the "pelefish" or paddle fish, the two species for which the Mississippi has always been most famous (Nuttall, 1904, p.326).

In the Illinois country, Father Marquette was entertained at a feast by the chief of the Illinois Indians. The second course consisted of a dish with three fish (Shea, 1852, p. 24). One historian suggested that they were probably the Mississippi catfish (Chambers, 1922, p. 37).

Many Indian legends and ceremonies developed around fish and fishing. Among the Sioux there was a feast called the "raw fish feast." In this ceremony the medicine men performed a dance and then ate raw fish, entrails, scales, everything but the head and large bones (Pond, 1889, p. 241). Tribes of the Great Lakes region thought that the knowledge of how to make nets for fishing was given to them by the gods.

There is a Menomini legend of the catfish and the moose, which explains why the catfish has a flat head. The catfish tribe, at the suggestion of their chief, decided to kill and eat the moose when he came down to the water's edge to drink. They all began to thrust their spears into the moose and made him so angry that he trampled them with his hooves. Many of the fish were killed and even those which escaped had their heads flattened by the huge moose (Judson, 1914, p. 180).

Black Hawk, the remarkable war chief of the Sac and Fox Indians in Iowa in the 1820's and 1830's whose name is associated with one of the most tragic of the Indian wars, reminisced as an old man about the happy way the "year rolled round" in the "times that were." He described the way the Indians planted and tended the corn until it was knee-high, when the villagers all prepared to leave for their summer occupations. The village of Black Hawk's people was probably somewhere in the vicinity of Dubuque, Iowa, because he mentions that some of the old men and women went to the lead mines. The young men went westward to hunt buffalo and deer. The older men and women who did not go to the lead mines started to fish and gather reeds to make mats. After about forty days, everyone returned to the village and the different groups made presents to each other. The hunters offered dried meat, the miners presented lead, and the "stay-at-homes" gave dried fish and mats for the winter lodges. *"This is a happy season of the year—having plenty of provisions such as beans, squash, and other produce, with our dried meat and fish, we continue to make feasts and visit each other until our corn is ripe"* (Black Hawk, 1932, pp. 76-77). The old war chief made other references to fishing as a source of food. At one time he fished to provide food for the family of a brave who had been executed for the murder of a white man.

The building of Fort Armstrong on Rock Island in 1816 was a source of unhappiness to the Indians because it was the best island in the river and had been their "garden." They were able to take "fine fish" in the river off the island, probably in contrast to "rough fish" taken elsewhere (Black Hawk, 1932, p. 70). (Wilkie, 1858, in quoting Black Hawk *uses* the term "pure fish").

Wilkie's book contains an account of a party of Sacs and Foxes and a party of Pottowatomies who fished near Davenport in 1812. The

groups camped near each other and when some of the braves in both camps became drunk, a fight ensued in which a number of men were killed (Wilkie, 1858, p. 44). The fact that members of two different tribes would fish so close to each other would seem to show that there were certain favored fishing spots along the river.

The Dakota chief Wabasha had his permanent encampment near the present site of the Minnesota town which bears his name. The Mississippi River at that point was considered an outstanding fishing spot, particularly for smallmouth bass (Streckfus, 1913).

A missionary working among the Dakotas at Red Wing, Minnesota, in the years from 1849 to 1852, reported that the Indians often paid for the flour and sugar which they obtained from the missionaries with fresh fish, choice pieces of venison, or wildfowl (Hancock, 1905, p. 173).

Major Thomas Forsyth, an Indian agent among the Sacs and Foxes, said that the only time the Indians ate fish was during the summer when they were "short of tallow" and then they fished day and night (Forsyth, 1912, p. 229).

While the records of fishing among the Indians are not abundant, it is apparent that fishing as an occupation and fish as food were of great importance to the economy of the tribes which inhabited the Mississippi Valley. The importance of fish to the Indians can be deduced from the prevalence of fish names. Some tribes gave fish names to a few of the months, and many Indians bore fish names. Na-mah (Sturgeon) and **Pau-k-hum-ma-wa** (Sunfish), the brothers of Black Hawk's great grandfather, are examples. One of the Sac chiefs who made the unfortunate sale of land to the whites by the treaty of 1804 in St. Louis was called Quash-Qua-me or "Jumping Fish" (Black Hawk, 1932, p. 27).

In the early records of travel and exploration in the Upper Mississippi Valley, there are many descriptions of game animals and birds, but relatively few of fish. As a man moved through the country on horseback, by stagecoach, by boat, or on foot, animals and birds were much easier to observe than were the fishes. If a traveler wanted to find out about fish in a body of water, he had to stop and do some angling. Fortunately, some of the explorers and early travelers did take time to fish and recorded what they caught.

Among the earliest explorers in the Upper Mississippi Valley were the two brothers-in-law, Groseilliers and Radisson, who were on the river in 1655 and 1656. They wintered on Prairie Island, five miles below Hastings, Minnesota, where fish were to be found in great numbers, according to Radisson's notes. During that time they had many feasts since they did not lack fish (Upham, 1905, p. 466). The two men were apparently very fond of fish, since they mentioned them in connection with many trips to Lake Superior, as well as on the

Mississippi. In speaking of the hospitality of the Indians and of the forest, Radisson wrote (Upham, 1905, p. 481):

> *"It is cheape when we are not to put the hand to the purse; neverthelesse we must* pay *out of civility: the one thanks to the woods, the other to the river, the third to the earth, the other to the rocks that stayes the fish . .*

For Radisson and Groseilliers, fish were an important and appreciated item in their diet.

Father Marquette, the Jesuit priest who was on the river with his friend Joliet in 1673, left vivid descriptions of the fish he saw. In his narrative he described their trip down the river (Shea, 1852, p. 117) :

> *"Here then we are on this renowned river, of which I have endeavored to remark attentively all the peculiarities . . . We gently follow its course which bears south and southeast till the forty second degree. Here we perceive that the whole face is changed; there is now almost no wood or mountain, the islands are more beautiful and covered with finer trees; We see nothing but deer and moose, bustards and wingless swans, for they shed their plumes in this country."*

Marquette said that from time to time they met "monstrous fish." One struck so violently against their canoe that he thought it was a large tree which would knock their canoe to pieces. In the Shea edition of Marquette's narrative, there is a footnote by Benjamin French of Louisiana (Shea, 1852, p. 117), which identifies the fish as *"probably the catfish of the Mississippi, (Silurus Mississippiensis). They sometimes grow very large and strike with great force anything that comes in their way."* Mr. Harry Canfield of La Crosse, Wisconsin, a long time employee of the U. S. Fish and Wildlife Service on the Mississippi, thinks it more likely that the "monstrous fish" was a lake sturgeon. He bases his belief on the fact that lake sturgeon swim much closer to the surface than do "catfish" and so were more likely to bump into a canoe. Lake sturgeon were extremely plentiful in early times.

The names given to fishes both by early explorers and recent anglers often make exact identification difficult. The names of fishes in this report follow the list recommended by the American Fisheries Society except where identification is impossible.

The strangest fish found in the Mississippi River is the paddlefish, ***Polyodon*** *spathula* (Fig. 2). It is not found anywhere except in the Mississippi River drainage. Its only known relative is found in the Yangtze River of China. Father Marquette left the following description of the paddlefish (Shea, 1852, p. 117):

"On casting our nets, we have taken sturgeon and a very extraordinary kind of fish; it resembles a trout with this difference, that it has a larger mouth, but smaller eyes and snout. Near the latter is a large bone, like a woman's busk, three fingers wide and a cubit long; the end is circular and as wide as the hand. In leaping out of the water the weight of this often throws it back."

Father Hennepin, the Franciscan friar who went with La Salle, told of seeing an otter on the riverbank with what appeared to be a devil between its paws. The men with Hennepin took the strange looking creature away from the otter and found that it was a fish. Hennepin said that in spite of its appearance the men ate it and found it good. Hennepin's veracity is not always above question, but the description he gave of the fish could be that of the paddlefish of the Mississippi (Shea, 1852, p. 136).

When La Salle reached the Gulf of Mexico on April 9, 1682, after his trip down the Mississippi, he took possession of *"the seas, harbors, ports, bays, adjacent straits, and all nations, people, provinces, cities, towns, villages, mines, minerals, fisheries, streams, and rivers within the extent of the said Louisiana"* (Mahan, 1926, p. 6). Perhaps he saw evidence on the river trip to make him believe that the fisheries were worth including in the possessions of the King of France, or, perhaps, it was just habit for a Frenchman to include them, since the French were among the earliest fishermen in the new world.

Father Anastasius Douay, a priest who traveled with La Salle and Tonty in 1687, wrote that the rivers in the Illinois country were so full of all kinds of fish that members of the exploring expedition were able to take them with their hands without using baskets or nets. One day, one of the men took from the Indians a fish head which was so big that it was a load for one man to carry (Shea, 1852, p. 227).

A fragment of a journal written in the Upper Mississippi Valley sometime around 1765 *was* found in a Connecticut kitchen in 1868. The author, Peter Pond, was a fur trader and adventurer. The spelling is unique and sometimes difficult to understand, but the account of fishing is one of the best of the early records (Pond, no date):

"We Put our Hoock and Lines into the Water and Leat them Ly all nite. In the Morning we Perseaved there was fish at the Hoocks and went to the Wattr Eag and halld on our line. They Came Heavey. At Lengh we Hald one ashore that wade a Hundred and four Pounds—a Seacond that was One Hundred Wate —a third of Seventy five Pounds. The Men was Glad to Sea this for thay Had not Eat mete for Sum Days nor fish for a long time. We asked our men How meney Men the largest would give a Meale. Sum *of the Largest Eaters Sade twelve men Would Eat*

it at a Meal. We Agread to Give ye fish if they would find twelve men that would undertake it. They Began to Dres it. The fish was what was Cald the Cat fish. It had a large flat Head Sixteen Inches Betwene the Eise. They Skind it—Cut it up in three large Coppers Such as we have for the Youse of our men. After it was Well Boild they Sawd it up and all Got Round it. They began and Eat the .hole without the least thing with it but Salt and Sum of them Drank of the Licker it was Boild in. The Other two was Sarved out to the Remainder of the People who finished them in Short time. They all Declared they felt the Beater of thare Meale Nor did I Perseave that Eney of them ware Sick or Complained."

This "fish story" has been reprinted in several places (*see* Havighurst, 1944, pp. 36-37).

Captain Jonathan Carver, another "Connecticut Yankee" in the Mississippi Valley, visited the Upper Mississippi River in 1767. He was interested in finding out what the natural resources of the region were, and in his account of the wildlife of the area he listed the fish which were taken in the Mississippi River. He mentioned two kinds of "sturgeon," "catfish," "carp," and "chub." Of the "freshwater sturgeon" he said that it was not like the "sturgeon of the sea." It was from two and one half to three feet long and had delicate and finely-flavored flesh even exceeding "trout." Carver described the method of taking the "sturgeon" *"by watching them as they lie under the banks in a clear stream, and darting at them with a fish-spear; for they will not take a bait"* (Carver, 1838, p. 293). Carver spoke of another sort of "sturgeon" found in the Mississippi "and there only." His description is of the paddlefish—"upper *jaw which extends fourteen or fifteen inches beyond the under and is of a gristly substance."* He said the flesh was not nearly as good as that of the sturgeon and even the Indians did not like it as well. He described catfish flesh as excessively fat and luscious and greatly resembling eel in flavor.

Carver gave a curious description of a fish hawk which resembled a "whipperwill." He said that it drew fish within its reach by some "attractive power" in its body, supposed to be an oil contained in a small bag. Any bait touched with *a* drop of oil collected from this bird was supposed to insure an angler's success, because it was an irresistible lure to the fish (Carver, 1838, p. 288). Carver was particularly impressed by the abundance of fish in Lake Pepin and by the depth of that lake.

Many of the explorers and travelers appended lists of shells and fishes to their accounts. Henry Rowe Schoolcraft published an annotated list of shells which he collected on his trip to the source of the Mississippi. He found seventeen species of shells in the Upper Missis-

sippi region (Schoolcraft, 1834, pp. 153-156). The "carp" referred to by most of the explorers was probably the buff alofish or the carpsucker because the carp was not introduced into America until much later. In his *Notes on Virginia,* Thomas Jefferson (1854, VIII, pp. 253-254) does distinguish between "buffalofish" and "carp." "Carp" in his list are probably the carpsuckers. Jefferson wrote:

> *"The Mississippi will be one of the principal channels of future commerce for the country westward of the Allegheny . . . This river yields turtle of a peculiar kind, perch, trout, gar, pike, mullets, herrings, carp, spatula fish of fifty pound weight, catfish of one hundred pounds weight, buffalo fish and sturgeon."*

Lieutenant Zebulon Pike's journal of his trip up the Mississippi in the late summer of 1805 has a few references to fishing, though many more to hunting. On August 12, he records the catching of one "catfish" and on August 14, near Clarksville, Missouri, he gives the amazing total of 1,375 small fish caught. There may be a tip to the angler in his comment on the weather. *"It rained all day."* August 16, he records three "catfish" and a "perch." On the return trip in the spring of 1806, he sent two men out in a canoe on Lake Pepin to set fishing lines. A strong headwind overturned the canoe and except for the timely assistance of some Indians the men would have drowned. The fact that he ordered men to set fishing lines would seem to show that the expedition was counting on fish to augment the food supply. Perhaps the winter camp at Little Falls (Minnesota) had depleted their supplies to the point where they were glad of any help from natural sources (Coues, 1895, I, pp. 2, 4, and 12). At one time two of Pike's men became lost on shore when they were searching for a dog which had strayed away. The only food they had for six days consisted of freshwater mussels (Mahan, 1926, p. 26). These mussels probably were found in little streams inland from the river, because if the men had been on the Mississippi shore they could have rejoined the expedition sooner.

Major Stephen Long of the Corps of Engineers, United States Army, voyaged to the Falls of St. Anthony in a six-oared skiff in 1817. The object of his trip was to *"meander and sketch the course of the upper Mississippi, to exhibit the general topography of the shores and to designate such sites as were suitable for military purposes"* (Long, 1890, p. 9). On Thursday, July 10, thirty-four miles from Prairie du Chien, Long noted in his diary that they had gone six miles before breakfast, and in that distance had caught five "catfish" and one freshwater drum. On the following Saturday night they caught several fish, and on Friday of the next week he reported that, being out of provisions at Sioux Valley, they had caught three fine "catfish" and had shot a few pigeons. Major Long's appreciation of the value of fish to

his men is shown by the following entry for Monday, July 21 (Long, 1890, p. 50):

"While we stopped to breakfast, caught several fish, which, since we have no meat, are become essential to a healthy subsistence, particularly as my men have hard duty to perform."

In the winter and spring of 1818, a young man, E[illegible] Evans, took a "[illegible] tour" through the western territories (Evans, 1904). In Tennessee he stopped to swim in the Mississippi River. He noted how very soft and muddy the water was. He reported that water from the river, when put in a tumbler, would deposit sediment equal to one-sixteenth part of the whole. *"It is, however, not very unpalateable and is, I think, not unwholesome. The fish in the river are numerous and large; but they are too fat to be delicate"* (Evans, 1904, pp. 305-306).

The Reverend Timothy Flint in his *Geography* (1833) listed the varieties of fishes to be found in the Mississippi River. He commented that the fishes of the Mississippi are generally rather tough, coarse, large, and unsavory. Flint reported that "[illegible]," set across the mouth of the Illinois River, where it entered the Mississippi, took five hundred pounds of fish nightly. He said that, except for "trout," the "small yellow catfish," the "pike," the "bar fish" and the "perch," the fish of the western waters were not much admired (Flint, 1833, p. 91). Perhaps the "trout" mentioned by Flint were largemouth bass, and the "bar fish" were probably the white bass, or yellow bass.

Prince M[illegible] of W[illegible] visited the western territories in 1843. He had a great interest in natural history and was a keen observer. He wrote especially of the fish of the Wabash River, but commented that the fish of the Ohio and Mississippi Rivers were much the same. He listed "catfish" of one hundred pounds, several species of "sturgeon and pike," the "horn-fish," and the "buffalo," which he compared to the cam. *"The remarkable paddle-fish is likewise met with, but not frequently nor in all the rivers. Mr. Le S[illegible] has given it the name of platyostra and has sent several specimens to Paris"* (W[illegible], 1904, p. 170).

Lieutenant Albert Lea mentions that the town of Catfish on Catfish Creek received its name from the number of "catfish" that were found in the sluggish water at the mouth of the creek (Lea, 1935, p. 40). Catfish Creek is a small stream near Dubuque, Iowa.

One would expect to find many references to fishing in the accounts of the forts built along the Mississippi River, but apparently the soldiers on the frontier were too busy to do much fishing, or, at least, to write about any angling they may have done. However, a few records have been found. In 1819, Major Thomas Forsyth, an Indian agent, accompanied Colonel Leavenworth on an expedition to [illegible]-[illegible] Fort Snelling, or Fort St. Anthony as it was first known. He [illegible]

not favorably impressed with the land above Prairie du Chien, calling *it "broken, rocky, and sterile country, not fit for either man or beast to live* in" (Forsyth, 1880, p. 160). Forsyth said that very few fish could be obtained from the Indians, although there were plenty to be caught in the rapids.

A bit of excitement occurred at Fort Snelling sometime in the 1820's when a son of Colonel Josiah Snelling fell into the river and almost drowned. His mother heard the shouts of people trying to save him and ran out to see what had happened. When the boy, Henry Snelling, revived, he told the excited people that he had been fishing and a huge "catfish" caught on his line had pulled him into the water (Anonymous, 1872, p. 431).

According to the records of the storekeeper at Fort Snelling, on a spring day in 1855 a soldier, Eli Pettijohn, invested $2.50 in "Fishing Tacker (Hansen, 1918, p. 88). The author of *Old Fort Snelling* seems to think that Eli was going to fish in some of the lakes around the Fort, but it is possible that he might have intended to fish in the old Mississippi which flowed almost by his door.

No records were found of pioneers who came to the region of the Upper Mississippi River with the definite intention of becoming fishermen. There is evidence, however, that they did fish for food and for sport. As late as 1858, in a list of occupations in Davenport, Iowa, there was no mention of fishermen, even though the listing was rather specific in mentioning two comedians, five loafers, two "Jack of all trades," forty-four butchers, eleven peddlers, one raftsman, and two boatbuilders (Wilkie, 1858, pp. 319-323).

In the *Davenport Weekly Gazette* of July 16, 1857, there is a comment by the editor that a friend of his caught nine fine "bass," one "pike," and three gars in the river in three or four hours of fishing. The editor of the *Muscatine Journal* stated in the August 13, 1869 issue: *"Fishing parties are fashionable now-a-days. For our part we should prefer lighter employment, such as sawing wood or carrying a hod to the seventh story of a building."* The next day's paper told of a 12 year old boy who slipped and fractured his arm while fishing from a log near the Round House. The November 19, 1857 issue of the *Davenport Weekly Gazette* stated: *"Fresh fish from the Mississippi are selling in the markets from* 10 *to* 12½ *cents per pound. The young salmon bring the latter price. These figures are two (sic) high, although we much prefer our own river fish to the lake fish brought here."* Apparently there were some market fishermen in or near Davenport *at that time.* It is uncertain what *was* meant by young "salmon" from the Mississippi, although the yellow walleye is probably the fish referred to. Commercial fishing apparently was well established around Quincy, Illinois, by 1869, for Redmond (1869, p. 190) *stated* that fresh fish from the Mississippi River and tributary streams was supplied the year

around by the following dealers: G. H. Hellman, Jenks and Curtis, J. Platt and Bro., Scott and Dervine, and Scott, Jenks and Co.

An early historian of Scott County, Iowa, said that when business was dull, the inhabitants of Davenport and its vicinity hunted and fished. He noted that around 1836 *"enormous specimens of the finny tribe were taken and to the newcomer were objects of surprise and curiosity"* (Barrows, 1863, p. 25). A little girl saw a one hundred and seventy pound "catfish" hauled up in front of a hotel in Rockingham, a town near Davenport. A large crowd gathered around to watch the fish flounder. The child ran home to tell her father that *"they have killed our old sow." "The river and forest furnished ample sport as well as food for the early settler"* (Barrows, 1863, p. 25). J. B. Walton (1893), writing about the early days in Muscatine, Iowa, told about the tons and tons of "buffalo fish" around Muscatine Island in 1842. He said there were so many fish of that species they would cover one hundred acres of land with probably ten tons to the acre. A favorite pastime was spearing the "buffalash."

The *Crawford County Weekly Courier* of Prairie du Chien, Wisconsin, was boosting the hunting and fishing opportunities in that region in the issue of June 16, 1852. Every kind of fish could be taken in the river, *"from a catfish of forty pounds to a tadpole."* The paper also mentioned the "barb-erous" sport of spearing fish.

In August of 1819, the price of fine fish was three cents per pound in the Illinois settlements (Flower, 1904, p. 108). A book written for Englishmen emigrating to Illinois in 1843 (Oliver, 1924) described how to catch fish with seines in the sloughs and backwaters of the rivers and how to shoot them with rifles. The quality of the fish was not considered very good. A warning was given the emigrant about the inhabitants of the region: *"The population of the great rivers and other thoroughfares is of a very mixed and doubtful character"* (Oliver, 1924, p. 68).

In the diaries of two Northwest farmers (Loehr, 1939) there are several notations concerned with fishing. William Brown, a farmer near St. Paul, Minnesota in the 1840's recorded in his journal the fishing trips made by his brother and a friend. In November, 1843, "Charley and Harrison" went to Kaposia one mild day, and caught nine fish. In the winter of 1846, they fished through the ice on the Mississippi and caught eight fish (Loehr, 1939, pp. 40 and 57). Mitchell Y. Jackson, who farmed near Hudson, Wisconsin, in the period from 1852 to 1863, did some fishing now and then. Sometimes he was successful while other times a day's fishing yielded nothing. On June 5, 1854, after he had finished a fishing trip, he left a net with some people who apparently lived near the river. The next day he picked up two fish, weighing a total of seventeen pounds, as his dividend for furnishing the net (Loehr, 1939, pp. 126 and 161).

For every recorded fishing trip on the Mississippi River hundreds went unrecorded. Mr. Harry Canfield of La Crosse, Wisconsin, who has worked and lived along the Mississippi River for many years has written (personal communication, 1952):

"All river folks, including boatsmen, lumberjacks, raftsmen, adjacent farmers, and nearby townsmen, caught and used fish as food in quantities. Fish were plentiful all along the rivers. Transportation to distant points was high, prices of all food stuff low, therefore, the industry did not flourish in a commercial way until later years. The Indians always fished for food, but to a limited extent, because furbearers gave them food and clothing, and furs and hides could be held and sold to provide guns and other supply needs, whereas fish *were perishable and plentiful for local consumption throughout the nation."*

II

CHANGES IN THE RIVER

The Mississippi River has constantly changed its course. The current cut new channels so often that steamboat captains had to be continuously on their guard to keep from running aground on new shoals or to keep out of false channels. The numerous oxbow lakes which have been cut off from the river are further proof of the constant shifting of the river channel (Fig. 3).

One great change in the channel has made an island of Kaskaskia, Illinois, site of the fort taken by George Rogers Clark during the Revolutionary War. This change has taken place within the memory of men still living. John Wolf, a commercial fisherman at St. Mary's, Missouri (across the river from Kaskaskia), said that fishing has not been nearly so good since the new channel was formed (John Wolf, St. Mary's, Mo., interview, August, 1950).

The river not only changes its course, but also its volume, rate of flow, suspended materials, and water chemistry. It is much more difficult to demonstrate long term changes in these characteristics than to chart the changes in the channel. Within a given year, the river may be extremely low or overflow miles of the valley bed (Fig. 4). The amount of silt carried varies a great deal depending upon the volume, rate of flow, and extent of flooding at any time. It is therefore difficult to evaluate the descriptions of some of the earlier observers.

Francis Parkman (1887, p. 251) wrote (probably from personal observation): *"The young Mississippi, fresh from its northern spring, unstained as yet by unhallowed union with the riotous Missouri, flowed calmly on its way amid strange and unique beauties."* The young man who took the "pedestrious tour" in 1818 (Evans, 1904), visiting the river below its juncture with the Missouri, wrote of the tremendous amount of suspended silt in the water.

Mark Twain (1923, p. 228) quoted Captain Marryat of the Royal Navy who visited western America in 1837:

> *"It contains the coarsest and most uneatable of fish such as catfish and such genus . . . . There are no pleasing associations connected with the great common sewer of the western America which pours out its mud into the Mexican Gulf, polluting the clear blue sea for many miles beyond its mouth."*

Mark Twain, loyal child of the river, commented that *"the catfish is a plenty good enough fish for anybody"* (Twain, 1923, p. 228).

There can be little doubt that the development and increasing settlement of the Mississippi Valley affected the character of the river and its fish. The deforestation, clearing of land, drainage, reclamation of swamp lands, leveeing of river banks, dredging and straightening of channels all were the usual accompaniments of agricultural and industrial development (Coker, 1930, p. 87). These changes accentuate the normal annual fluctuations in the river. Rains run off the land more rapidly, thereby increasing the floods and leaving less water to maintain the flow during dry seasons. The removal of the natural watershed cover has also increased the amount of silt brought to the river.

In its original condition the Mississippi consisted of a series of relatively deep pools separated by shallow bars and rapids. The channel *was* obstructed by rocks and snags. Low water made stretches of the river impossible to navigate, while at higher stages it was navigable to St. Paul (U. S. Army, Corps of Engineers, 1948, p. 5). One does not have to read very far in the history of the river to discover that navigation has always been the paramount consideration.

The problems of navigation led to a program for river improvement. It is quite apparent from the reports of the Mississippi River Improvement Committee, which was organized about 1845 and was still active as late as 1911, that Mississippi River "improvement" was for one purpose only: To keep the river open as a highway of commerce, a highway which only incidentally happened to be made of water. In the Committee's reports, no mention of the fishery resources of the river was ever made. In 1866 the Committee, made up of grain producers from Iowa, Wisconsin, Minnesota, Illinois, and Missouri, met to urge Congress to appropriate money for channel improvement. They wanted a channel three hundred feet wide and four feet deep. This was just one example of the many times they memorialized Congress for river improvement.

The Game and Fish Commissioner of Minnesota (Biennial Report, 1924, pp. 57-58) made an urgent request in 1924 that the legislature memorialize the U. S. Congress to amend the River and Harbors Act so that wild *life* and fisheries would be considered in the operation of the storage reservoirs on the Upper Mississippi River. He pointed out that only navigation had been considered when the act was passed in 1880 and stated that *"the low water level seriously interfered with the spawning of game fish, particularly the wall-eyed pike. Inasmuch as Minnesota is practically the last stand of the desirable wall-eyed pike, it seems necessary, if this species is to be perpetuated in our waters, that some attention be given to the maintenance of a uniform stage of water twelve months of the year in the headwaters of the Mississippi."*

The Corps of Engineers of the U. S. Army has been in charge of the improvement work on the Mississippi since a survey of the Mississippi and Ohio Rivers was authorized in 1820. The main objective has been to maintain a channel of sufficient depth for boats and barges. At first the work consisted of removing snags and wrecks from the channel. Later, attempts were made to keep the channel open by dredging and by building wing dams and revetments. No permanent cross-stream dams were built by the Corps of Engineers prior to 1930.

In 1878, work was begun to establish a four and one-half foot channel between Minneapolis and the Missouri River. This channel was deepened to six feet, then to eight feet, and finally, to nine feet. There is now talk of making a twelve-foot channel. It was found impossible to keep a channel open by dredging and wing dams alone, and in 1930 Congress authorized improvement by means of locks and dams, supplemented by dredging. There are, at the present time, twenty-six dams between Minneapolis and the Missouri River (U. S. Army, Corps of Engineers, 1948, pp. 5-6 and 185). These dams have converted the river into a series of lakes (Fig. 1), as described by Greenbank (1945, p. 18):

> "*It* is a stretch of interesting and varied topography; but the configuration of the water course is now largely controlled and defined by the series of dams. Each dam, separated from the next by a distance of from fifteen to thirty miles, creates a flat *pool* of several miles in length. . . . The partial impoundment of the river has brought, and is bringing, about many distinct changes in the water topography, and hence in the conditions which make up an environment for fish and wildlife."

One of the effects of the dams has been an increase in the permanent water area. The impoundment above the Keokuk Dam covers sixty square miles at low water stages; before the dam was built there were only thirty-six square miles of river surface at low water. Since impoundment, the difference between the water area at high and low water stages has decreased. Coker (1930, p. 92) reported that Keokuk Lake had only four square miles more water area at high water level than at low, after impoundment. Before Keokuk Dam was built, the difference in area at high and low water levels was eighteen square miles (Fig. 5).

The change in the river current probably has been more important in affecting the fish and fishing than has the increase and stabilization of the water area. The current in most of the river from St. Paul to Alton, Illinois, has been greatly reduced. As the current slows, the silt settles out, covering sand and gravel bars which are essential for some species of fish, mussels, and of insects, crustaceans, and other organisms which are important as fish food.

There has been a great deal of controversy about the darns and their effect on fishing in the river. The commercial fishermen themselves do not agree on whether they have been beneficial or not. Many feel that while there are more fish, the presence of submerged snags makes them more difficult to catch. The activities of the Army Engineers on the Upper Mississippi have been discussed and debated heatedly from Mark Twain's day to the present (see Mark Twain's *Life on the Mississippi).* The effects of the dams on the fish and fishing in the river probably have been more qualitative than quantitative. The change of the river to a lake habitat has favored some species while working to the disadvantage of others.

The highest dam on the Mississippi, the Keokuk Dam at the Des Moines Rapids, was not built by the Army Engineers, but by a private power company. Completed in 1913, it was, at the time, one of the largest power dams in the United States. Since then it has been dwarfed by many of the dams in the TVA and the far west.

Shortly after the Keokuk Dam was completed, the U. S. Bureau of Fisheries initiated a study of its effect on the fish. Dr. R. E. Coker began the study in 1914 and completed it in 1929 (Coker, 1930). There is no fishway in the dam and Coker found that the fish did not use the lock effectively as an upstream passage, since there is no current in it and it is out of the main channel of the river. He thought that fish probably did not go downstream over the dam, because conditions in Lake Keokuk were similar to those they would seek downstream.

There was evidence that the dam was a barrier to extensive upstream migration of paddlefish, American eel, skipjack, Ohio shad, buffalo, shortnose gar, freshwater drum, carp, shovelnose sturgeon, and three species of catfishes. Sauger movements were interfered with during the winter. The only fish likely to have their spawning interfered with were the skipjack, the Ohio shad, and the blue sucker, none of which were very important as commercial or sport fishes. However, this interference was of great importance in the case of the skipjack, because it is the host for the larval form of the important "niggerhead" mussel, so valuable in the button industry (Coker, 1930, p. 106.) The American eel spawns in the ocean and then migrates up the Mississippi River to live for several years before returning to the *sea.* Only the females come to the Upper Mississippi whereas the males remain near the sea. Coker predicted that the exclusion of the American eel, the blue catfish, and the paddlefish from the upper river would result in the loss of fishery products valued at several thousand dollars annually (Coker, 1930, p. 106). In the 1930's and 1940's there apparently were fewer paddlefish, no skipjacks, probable fewer blue catfish and fewer American eels above Keokuk Dam than prior to 1910. However there were other factors which changed after the dam was built and these may also have influenced the decline of these species.

The blue sucker *(Cycleptus elongatus)* was at one time a fairly important commercial species in swift parts of the river (Bamickol and Starrett, 1951, p. 292). By 1926 it virtually had disappeared and in that year Coker found practically no fishermen in the Keolcuk area who had seen more than two or three blue suckers a year. In an interview with Dr. William Starrett (personal communication, 1953), Mr. Knipe, a commercial fisherman at Nauvoo, Illinois, stated that before 1910 the Keokuk Rapids was a great producer of blue suckers and buffalofishes, but that after 1910 the catch of blue suckers dwindled rapidly. The removal of the Le Claire and Keokuk Rapids and the construction of the Keokuk Dam were considered important factors in the decline of the blue sucker in the section of the river between Dubuque and the Missouri River. However, Coker found that this species had declined also in the Mississippi between the Missouri River and Caruthersville, indicating that there were other causes for its decline (Barnickol and Starrett, 1951, p. 293).

Barnickol and Starrett (1951, p. 288) state that on the basis of commercial catch statistics from various years it is apparent that *"the carp, buffalofishes, catfishes and freshwater drum (Aplodinotus grunniens) have not been so greatly affected by man's modifications of the river as have the paddlefish (Polyodon spathula), lake sturgeon (Acipenser fulvescens), and American eel (Anguilla bostoniensis)."*

Some of the difficulties of obtaining accurate information about the fish and fishing in an area are shown by the experience of investigators in the vicinity of the Keokuk Dam. There had been a rumor that there were enormous numbers of fish in the Des Moines River in September, 1913, shortly after the completion of the darn. As the dam is three miles above the mouth of the Des Moines River, the inference was that fish unable to go up the Mississippi were going up the Des Moines. Nineteen persons were interviewed and the information gained *"served to throw rather more light upon human psychology than upon the actual effects of the dam"* (Coker, 1930, p. 108). There was no actual evidence that there were more fish in the Des Moines River, but one person had heard that there was an increase and another, who never fished, thought that there must be more in the Des Moines River than there had been before.

To maintain navigation with the present system of dams and locks, it is sometimes necessary to release water from upper pools to keep an adequate depth for boats in certain stretches of the river near St. Louis. These sudden and drastic lowerings of water in the upper pools often left thousands of fish stranded in pools isolated from the main channel. On many occasions thousands of fish were killed and sportsmen were much concerned over the losses. The Upper Mississippi River Conservation Committee and the Corps of Engineers cooperated in a study of the winter draw-down problem (U. M. R. C. C., 1948)

and some modifications have been made in the manner and extent of draw-down to decrease the fish loss.

The building of towns and cities along the river has led to considerable pollution of the Mississippi from sewage and industrial wastes. The condition of the river between Minneapolis and Lake Pepin became so serious that a survey was ordered by the legislature of Minnesota in 1927. Cooperating with the Minnesota Department of Health were the Commissioner of Game and Fish, the Wisconsin State Board of Health, and the Metropolitan (Minneapolis and St. Paul) Drainage Commission (Minn. State Board of Health, 1928, p. 4). Experienced employees of the Minnesota Game and Fish Department and of the U. S. Bureau of Fisheries carried on seining operations in the area between Minneapolis and Lake Pepin. The data obtained indicated that the fish generally shunned grossly polluted waters where the dissolved oxygen content was low. There also appeared to be a dearth of game fish in the river from Minneapolis to Lake Pepin as compared with the number found in the river immediately below the lake and in some of the tributaries (Minn. State Board of Health, 1928, and Wis. State Board of Health, 1927).

The biologists listed the following ways in which fish life might be endangered by pollution (Minn. State Board of Health, 1928, p. 114) : 1. Killing the fish directly; 2. Preventing the normal increase of fish, i.e., it may influence reproduction adversely; 3. Changing the environment so as to repel adult fish by an obnoxious condition of the water itself; 4. Causing fish to seek new environment as a result of destruction of natural food.

Commercial fishing has been greatly reduced, or completely destroyed, in some places because of pollution. Commercial fishermen in the vicinity of St. Louis complain about a gassy or oily flavor to the fish caught in that region. Even as far south of St. Louis as Ste. Genevieve, about 55 miles, fishermen said that fish caught during periods of low water were ill-flavored. There is practically no commercial fishing at the present time between St. Louis and the mouth of the Kaskaskia River (Barnickol and Starrett, 1951, p. 275).

During World War II, the Water Quality Laboratory, a unit of the Fish and Wildlife Service, was directed to analyze water samples from the Mississippi River for pollution. Dr. Wesley Platner (1946) undertook the study under the direction of the late Dr. M. M. Ellis. Platner reported that there are types of pollution which do not have as direct an effect on public health as does sewage, but have a more direct effect on fish. He tested industrial wastes which developed as a result of the war effort. He took a complete cross section of the river at certain points—where it was particularly wide, where there were islands, and at centers of pollution. He believed that there were only a few points on the river where pollution from sewage was serious.

Much of this pollution was confined to local areas because darns which had been built for impounding water held it there, but the pollution did not extend very far below the area of concentration. Dr. Platner was more concerned about siltation, which he considered the most serious pollution problem from the standpoint of the river fisheries.

Man has changed the Upper Mississippi River both deliberately and indirectly. These changes have had their effect both on fish and on fishing methods. It is almost impossible to separate the effects of the various changes, or even to say whether the individual changes were ,favorable or unfavorable to the fishery resources of the river.

III

FISH PROPAGATION AND RESCUE WORK

The 1870's were years of increasing alarm over the disappearance of fishery resources in the United States and the Upper Mississippi River Valley. On February 9, 1871, by a joint resolution of the House and Senate, the office of the United States Commissioner of Fish and Fisheries was established (U. S. Comm. Fish and Fisheries, 1873, p. xli). The position was without salary and Dr. Spencer F. Baird of the Smithsonian Institution was appointed the first Commissioner. In 1874, Wisconsin, Missouri, Iowa, and Minnesota set up their first fish commissions and Illinois followed suit in 1879 (Wisc. Comm. Fish, 1910, p. 13; Bennitt and Campbell, 1950, p. 118; Iowa Fish Commission, 1876; Minn. State Game and Fish Comm., 1924, p. 7; Ill. State Fish Comm., 1901, p. 13).

The U. S. Commissioner of Fish and Fisheries was authorized at first only to make investigations, but in 1872 his duties were extended to include the artificial propagation of fish, at the suggestion of the American Fish-Culturists Association, now the American Fisheries Society, which met in Albany, N. Y., February 7, 1872 (U. S. Comm. Fish and Fisheries, 1874, p. xvi). That year Messrs. Seth Green and Clift, in behalf of the U. S. Government, placed 30,000 American shad *(Alosa sapidissima)* in the Allegheny River and 25,000 in the Mississippi River a few miles above St. Paul, Minnesota. It was recognized that the stocking might not be successful *"but the results to be obtained, in the event of its possibility, are of such transcendent importance to the food supply of the country, and the cost of the experiment so very trifling, that it would be inexcusable not to attempt it"* (ibid. p. xviii). *"The prime object was to introduce the fish into the waters of the Mississippi Valley since these waters are by their nature the common property of the Union.. . . Young fish introduced into. . . Upper Mississippi in Minnesota . . . would in their return from the sea, traverse a large number of states, and, of course, be liable to be captured at any point before reaching their spawning ground."* (ibid. p. liv). Dr. Baird noted that China's largest river, the Yangtze, contained abundant "shad" and that the distance the fish would have to travel to the waters of all the tributaries of the Mississippi, except the Upper Missouri, was much less than that traversed by the "shad" of China. In the Mississippi, the American shad would encounter no falls or current of inconvenient strength and it should be no more difficult for

the fish to swim up river than to sweep along in schools from one part of the coast to the other. Despite the fact that this species does not feed in fresh water, it should not keep them out of the Mississippi since fish often go without food for several months. With respect to whether the Gulf of Mexico might be too warm for American shad, Dr. Baird pointed to the "recent researches of the Coast Survey" which showed directly outside the mouth of the Mississippi, an immense area where the depths range from 1,200 to 6,000 feet, with temperatures of 35° to 29°, even in the summer. Finally he stated, *"One great argument in favor of the attempt to introduce the shad, as well as species of salmon, into the Mississippi and its main tributaries, is the general absence of dams as compared with the waters of the Atlantic Coast. There is, even now, nothing to prevent fish from running* up *to a great distance, even to places where excellent opportunities for spawning can be had."* (U. S. Comm. Fish and Fisheries, 1874, p. lvii).

The Iowa Board of Fish Commissioners was formed in 1874 with B. F. Shaw as the first commissioner. He was an enthusiastic advocate of planting fish in every available stream including the portion of the Mississippi which formed the eastern boundary of Iowa. He was particularly interested in the planting of American shad and reported that a two-year old fish had been caught at Clinton in 1874. It was one, he thought, of the 22,000 which had been placed in the Mississippi at St. Anthony Falls. Two other specimens were caught at different points in the river in 1875. Shaw wrote in his first report to the Governor (Fish Comm. Iowa, 1876, p. 22): ". . . *it is confidently hoped that next year, the season of their anticipated return, may prove the success of shad-culture in western rivers."*

In his fifth Biennial Report (1884), B. F. Shaw reported that the U. S. Fish Commission had planted shad quite extensively in the Mississippi. He admitted that they had not been caught at all points on the river, but added that in some tributaries, notably the Ohio and Arkansas Rivers, they had been caught in goodly numbers for several years, and a few were caught in the lower portions of the Des Moines River. A few specimens were taken at other points on the Mississippi. (It is quite likely that even these fish were not the Atlantic shad, but the native Ohio shad, threadfin shad, river herring, or gizzard shad). Still hopeful, Mr. Shaw concluded (pp. 8-9): *"I think it is an established fact that the Mississippi will in time prove to be a shad river."* The Sixth Biennial Report (1886) declared that shad planting in the Mississippi River was a failure. It is perhaps significant that this sixth report was made by a new Fish Commissioner, Mr. A. W. Aldrich. In the ten years from 1874 to 1884, 1,340,000 American shad were planted in the river (Fish Commission of Iowa, 1886, p. 689). Thousands of Atlantic salmon *(Salmo salar)* were also unsuccessfully stocked. This seemed to be a trend of the day, not only by Mr. Shaw, but by most other fishery workers.

The species of fish which was most successfully planted in the United States in the late nineteenth century was the carp *(Cyprinus carpio).* In fact, the planting was so successful that the poundage of carp has exceeded that of any other fish in the commercial fisheries of the Mississippi River since 1900. It has also become a great problem in many lakes and rivers throughout the United States. Dr. S. P. Bartlett, of Quincy, Illinois, reported that specimens of carp were taken from the Mississippi River above Quincy by hook and line in September, 1883. Someone asked Bartlett if carp had been planted in the rivers. This was his reply (Smiley, 1886, p. 689) :

> *"as we value carp too highly to experiment with them by putting them into the river, those taken must have escaped from live boxes or from ponds. It nevertheless demonstrates the practicability of eventually stocking our streams with this wonderful fish."*

Dr. Bartlett was a staunch champion of the carp as a food fish and defended it long after most fishery workers had decided it was a nuisance (Fisheries Service Bulletin, Jan., 1921).

Besides planting carp, American shad, and Atlantic salmon in the Mississippi, the U. S. Bureau of Fisheries planted many native fishes in the river. Thousands of centrarchids, freshwater drum, catfishes, buffalofishes, and many other species were placed in the river by the Commission (Fish and Game Warden of Iowa, 1904).

Closely related to the fish planting program was what came to be known on the Upper Mississippi River as "fish-rescue" work. The spring floods submerged the lowlands along the river's course and as the waters receded, pools and lakes cut off from the main channel of the river were formed.

The "June rise" is the most important flood from the fishery standpoint, since it occurs at the time that most of the fish are ready to spawn and seek the quiet backwaters to deposit their eggs. Conditions are favorable for the growth of the fish in these backwaters and the young fish often are several inches long before the waters begin to subside. As the floods recede, many of the adult fish return to the main channel, but many of the young fish are stranded in the pools. The temporary pools are of various shapes and sizes. Some become dry in a few days, others last for weeks or months while the water slowly evaporates or seeps away. A few continue until winter when they freeze almost to the bottom. The landlocked fish die, either quickly when the pools become completely dry, or more slowly in the larger pools as the water disappears and the fish are crowded and starved, and finally smothered if the pool freezes (Smith, 1920, pp. 369-373).

The idea of rescuing the fish from these landlocked pools and placing them in the main channel of the river originated with B. F. Shaw, the first Fish Commissioner of Iowa. Dr. Hugh M. Smith (1921) gave the credit for originating the project to S. P. Bartlett, but Dr. Bartlett

(1910) himself said that he learned about fish rescue work from B. F. Shaw.

After making a study of the reasons for the scarcity of fish and what might be done to remedy it, Shaw hit upon the idea of obtaining young fish from the overflow regions of the river. One reason this method interested him was that it was cheaper than artificial propagation. In 1877, Shaw spoke to a group of fish-culturists at a meeting in Chicago about his experiments in taking fish from the flooded areas along the river, but he received only perfunctory attention because artificial propagation was the "all-absorbing interest" of the time (Bartlett, 1910).

The rescue work began in Iowa in 1876 and grew in volume and importance through the years until the nine-foot channel was constructed, stabilizing the water level. In answer to Shaw's request, the Sixteenth General Assembly of Iowa appropriated $1,000 for the work. A launch, the "Fire-Fly," was chartered and outfitted. It left New Albin, near the northern border of Iowa, on September 7, 1876, for its first trip. A total of 1,574,200 fish were taken, including "black, yellow, and striped bass, crappies, sunfish, perch, drum, walleyed pike, river herring, skipjacks, and minnows." The numbers were estimated at 20,000 to a bushel. About 320,000 fish were put into other streams and the rest were turned into the Mississippi (Fish Commission of Iowa, 1877, pp. 3-10).

The method of taking and distributing the fish did not change very much during the entire period from 1876 to 1930, except for the improvements which were made possible by increasingly rapid transportation. The personnel requirements and the equipment used remained basically the same (Figure 6).

A crew of five or six men seined the overflow ponds with fine-mesh seines of varying lengths. Small dipnets were used to transfer fish from the seines to galvanized iron tubs. The fish were sorted into tubs and taken as soon as possible to open water. Usually the men could carry the fish to the main river, but some ponds were so far removed from the river that teams and, later, trucks were used to transport them.

A small launch was used to take the crew to and from headquarters and flat-bottomed rowboats were used on the ponds which w,ere too deep for wading. Some of the ponds were really lakes, requiring many seine hauls, while others were so small that one sweep of the seine would remove all of the fish (Smith, 1920).

While most of the fish thus rescued were placed in the main stream of the Mississippi, some were used to stock other waters. This stocking was accomplished through the use of "fish cars," also called "aquarium cars." The first one was a freight car which B. F. Shaw fitted out with aquarium tanks and other necessary equipment. The railroads carried the car and crew free of charge and they shuttled back and forth across the state, carrying fish to inland waters (Fish Commission of Iowa,

1877). Later, when the U. S. Bureau of Fisheries entered the rescue work, they used first wooden and then all-steel distributing cars with permanent crews and all the latest improvements for keeping fish supplied with water and air. These cars were hauled on fast passenger trains (Smith, 1920, p. 386). Many veteran employees of the state conservation departments of Upper Mississippi Valley states and of the U. S. Fish and Wildlife Service were members of "fish car" crews and still remember the name or number of the car on which they served. As late as 1945, hatchery-reared fish were hauled in fish cars.

In the fall of 1878, the Iowa Fish Commissioner and his crew made a trip down the river, collecting an estimated 3,290,000 fish at a total cost of about twenty-five cents per thousand. On this excursion, the entire crew, except the Commissioner, came down with malaria or the ague (Fish Commission of Iowa, 1880, pp. 11-12). The work was not particularly healthful or pleasant since it had to be done in low marshlands under a hot sun. Nettles and other weeds added to the discomfort of the crews. A description of the work was included in a report of the Fish Commissioner of Missouri in 1886 (1887, p. 15):

> *"The work is a very disagreeable and unhealthy one, requiring men to work in a hot sun in mud holes, and sleeping in the bottoms at night necessarily produces malarial fevers. Good men cannot be hired to do such work for cheap wages."*

The mother of a man who died after several years of work on one of the fish crews had her son's tombstone engraved: *"Died of overwork at the fish hatchery"* (G. L. Gill, interview, Oct., 1949).

The rescue work spread from Iowa to the other states bordering the Mississippi. Dr. Sylvester Bartlett, inspired by B. F. Shaw, started the work in Illinois on both the Illinois River and the Mississippi (Bartlett, 1910). He later went to the U. S. Fish Commission where he carried on the same work.

With the aid of E. R. Shaw, *"the son of the present most worthy Fish Commissioner of Iowa,"* the Missouri Conservation Department began rescue operations in 1881. An expedition was ready to start at the northern border of the state, not far from Keokuk, Iowa, under favorable auspices (Missouri Fish Commission, 1883, p. 8):

> *"But alas! The rains began at an unusually early period and continued until the Mississippi overflowed its low lands, released the young fish and compelled us to abandon the expedition after the expenditure of a considerable sum of money from our limited appropriation."*

No attempt was made by Missouri in 1882 for lack of funds and *"the acute remembrance of our reverses in 1881, from causes entirely beyond our control"* (Missouri Fish Commission, 1883, p. 8). Some work was done in Missouri in 1886, although during July and August

the weather was too hot for fish to be handled. The Commissioners were still asking for funds for rescue work, apparently without success, as late as 1891 and 1892 (Missouri Fish Commission, 1893, p. 7). Missouri developed a great interest in the rescue program in the late 1920's and 1930's when the work had passed its peak in other states.

Simpson (1917) states that the first rescue work in the region of Prairie du Chien, Wisconsin, was done by private groups, particularly the Winona County Fishermen's Association and the Latsch Board. However, in the Biennial Report of the Commissioner of Fisheries of Wisconsin (1895), James Nevin told of the objections of some sportsmen when the Commission crews were taking fish from the river at Prairie du Chien. According to the report for 1893-94 (Madison, 1895) the Commissioners decided, in the summer of 1893, to save "black bass" from the Mississippi overflow areas. They deposited "the common varieties" of fish in the nearest channel waters and saved the "bass" and "pike" for distribution to other portions of the state. It was this practice of sending game fish to other lakes and streams which was the basis for most complaints about the rescue work. In the 1895 report, Superintendent Nevin recommended that the Commission have a boat built with a cabin and kitchen so that the men working on the river would have a place to eat and sleep. In a later report (1909-10) he reported that a houseboat had been purchased for $125 and fitted out at a total cost of $273.12. Apparently the crews in the intervening years had to find their "bed and board" wherever they could.

In 1909, the Wisconsin legislature passed a law which directed that the license money paid by the commercial fishermen on the Mississippi River should create a separate fund to be used for the rescue of fish from the sloughs and bayous adjacent to the river (Chap. 428, Laws of 1909; Supt. Rept. 1911-12).

The rescue work in pool 10 near Cassville, Wisconsin, in the winter of 1939-40, is described by the Reverend Mr. Leander L. Strodtman in the Wisconsin Conservation Bulletin for March, 1940. The water in the pool was dropped at the end of the boating season to prevent ice jams at the dam and to facilitate the cutting of timber on certain flooded areas. Sportsmen requested help in rescuing the game fish trapped in the sloughs where they would surely have suffocated. A crew of four men from the Wisconsin Conservation Department worked with local residents, seining under the ice and rescued 100,000 fish (Strodtman, 1940, p. 17).

The U. S. Fish Commission started fish-rescue operations in 1889 under the direction of S. P. Bartlett at Quincy, Illinois (Fisheries Service Bulletin, Jan. 1921). Gradually the Federal Government took over regions where no state rescue work was being conducted or where agreements were made with the states (Table 1). The number of rescue stations was at the maximum in the years 1917 to 1923. No

special funds were appropriated for the work until 1922. Before that date, money and personnel were taken from other activities of the Fish Commission (Smith, 1920).

TABLE 1.—S[illegible] U. S. B[illegible] F[illegible] ([illegible] F[illegible] C[illegible])
[illegible] M[illegible] R[illegible]
([illegible] F[illegible] S[illegible] B[illegible] *Annual*
R[illegible] U. S. B[illegible] F[illegible])

M[illegible]
Brownsville, 1921-22
Dakota, 1922
Hastings, 1924
Homer, 1911-38
Lake City, **1917**
Latsch Estate, 1921-22
M[illegible], 1917, 1922
Minnesota City, 1921-22
Red **Wing,** 1918
Richmond, 1917
Winona, 1917, 1922

W[illegible]
Ferryville, 1921-23
Fountain City, 1917-21
L[illegible] **Crosse,** 1904-38
Lake **Pepin,** 1917-18
L[illegible], 1917-38
Genoa, 1917, **1922–23,** 1931, 1938
Prescott, 1921-22
T[illegible], 1917
W[illegible], 1928
Wildlife Refuge, **1933,** 1937

I[illegible]
Bellevue, 1903-38
Fairport, 1917-38
Gordon's Ferry, 1922
Guttenberg, 1921-23, 1939
Montpelier, 1923
North McGregor (renamed Marquette, 1921), 1904-89

I[illegible]
Andalusia, 1928-30
Cairo, 1919-22
Galena, 1917
Lake Cooper, 1917
M[illegible], 1894-1904, 1918-22
New Boston, 1918
Quincy, 1889-1921
Rock **Island,** 1922-28

M[illegible]
Canton, 1919
Clarksville, 1919-20
Hannibal, 1920

L[illegible] M[illegible]
1917-30

The reports of the United States Fish Commissioner and of the various State Fish **Commissioners** contain lists of the species and numbers of each species which were planted in the various waters and in many years the numbers ran to several million. Private groups sent applications for fish to be planted in their favorite fishing sites. When the fish cars made their trips inland, the applicants were notified where they were to meet the train to receive their quota of fish.

In some years, notably 1908, the water in the river was so high that no rescue work could be done. The Iowa Fish and Game Warden pointed out that while this may have been good for the river itself, it was unfortunate for the inland sportsmen who had to wait another year for fish to stock their lakes. Because of the high water in 1907 and 1908, all the streams tributary to the Mississippi, "the great source of supply for all our waters," were thoroughly stocked with native fish and many large "catfish" were caught from interior rivers (Fish and Game Warden of Iowa, 1909, p. 5).

The Bureau's rescue work in 1916 was delayed by high water and hot weather. The heat made the transportation of the fish difficult if not impossible and the ones which were rescued were put into the main channel of the river. In September of 1916, Glen C. Leach, Superintendent of the Manchester station, was called to Washington

regarding an extension of the rescue work. A sudden freeze-up in November brought to an end a year of operations so successful that the Commissioner of Fisheries sent a letter of commendation to Superintendent Booth of the Homer station. The crews had even hauled seines under three or four inches of ice. From this one station alone, 3,324,525 fish were rescued. Seventy-five thousand, or less than 2.25 per cent, were planted in waters other than the Mississippi. The Superintendent at Homer had had the cooperation of the Winona Fish and Game Club in October and November. He had loaned them a collecting outfit and they had rescued 535,752 fish in one month (Fisheries Service Bulletin, Oct., 1917, Dec., 1916, and March, 1917).

In August, 1917, the stations at North MacGregor and Bellevue, Iowa, opened with full crews and made good collections. One carload of fish was sent from Bellevue and two from North MacGregor. At Homer, Minnesota, a houseboat was built to serve as a mess hall for the crews. A fast launch was provided to take fish to the Homer station. Aquarium cars took Mississippi River fish to New York, Pennsylvania, Michigan, and Colorado (Fisheries Service Bulletin, Sept., 1917). In September of that year, the crew at Homer was working full force and also cooperating with several local fishing associations. The Bureau's crews rescued 3,500,000 fish during September and the sportsmen saved probably 1,000,000 more. The river stage was much below normal.

The U. S. Commissioner of Fisheries submitted a detailed report of rescue operations for the fiscal year of 1917 to the Secretary of Commerce in November, 1917. The report was submitted to the Speaker of the House of Representatives, especially for the use of the Committee on the Merchant Marine and Fisheries and of the Committee on Appropriations, as well as for the information of the House of Representatives itself. Except for a few thousand fish captured at Friar's Point, Mississippi, all of the work reported was in the region of the Upper Mississippi River. Secretary of Commerce, William C. Redfield, pointed out that the report was significant because of its effect upon the food supply of the entire Mississippi region and because of the possibilities which it showed for further increasing the supply of fish. He said in his letter of transmittal: (U. S. House of Rep., House Documents, 65th Cong., 2nd Session CXIII, 393: *"It would seem evident that we should not allow 20,000,000 or more good fishes to be lost annually for lack of care."*

The cost of the rescue operations in 1917, including the salaries of the regular employees, was about $15,000. The value of the rescued fishes if purchased from commercial fish-culturists would have been about $175,000. In a report by Commissioner H. M. Smith, the following optimistic estimate of the value of rescue work was made (House Documents, 65th Cong., 2nd Session, CXIII, 1-3) :

"Basing an estimate on results obtained at fish-cultural stations and assuming that 60 per cent of the foregoing rescued fish would survive the natural mortality and reach a marketable size, it appears that the value of these fishes at present market prices paid to the fishermen would be ***approximately $500,000."***

The Commissioner, in his report to the Secretary of Commerce, noted that the Bureau's operations covered about 40 per cent of the available fields. He said that the Bureau of Fisheries could increase its coverage to 75 per cent of the available fields without interfering with the work of any of the states and that the number of fish rescued could be increased 300 or 400 per cent at an increase in cost not to exceed 100 per cent.

In the fall of 1917 the government was interested in every means of increasing the food supply of the country and this was one of the reasons for the special report to Congress. The statistics were to be furnished to Herbert Hoover, then the food administrator. The results of the rescue work so impressed President Wilson that on February 27, 1918, he approved an allotment of $20,000 from the fund for national security and defense for rescue work in the Gulf States. C. F. Culler, Superintendent at the Homer station, was appointed to take charge of the work in the southern states (Fisheries Service Bulletin, March and April, 1918).

Over seven million more fish were rescued in July of 1918 than in the same month of 1917. There was unusual abundance of carp and "black bass." The cost of rescuing food fish during the fiscal year of 1918 was the lowest rate ever attained, ranging from nine to fifty-four cents per thousand (Fisheries Service Bulletin, Sept., 1918).

By the time the season closed on November 18, 1918, a record total of 54,957,830 fish had been seined. The cash value of these fish at rates charged by commercial hatcheries was said to be greater than the total appropriation for fish culture. A Minnesota newspaper (Winona Republican Herald, Oct. 17, 1918) said that one day's rescue saved more fish than could be bred at the Homer station in a year (Fisheries Research Bulletin, Nov. and Dec., 1918).

In 1919, Minnesota, Wisconsin, Iowa, and Illinois decided to let the U. S. Bureau of Fisheries assume entire charge of the rescue work along their boundaries. The state conservation departments gave the Bureau the use of their holding stations and rendered assistance to the Bureau's employees (Fisheries Service Bulletin, Sept., 1919). The states' transfer of their share of the work to the Federal Government is of interest and importance, since at a later date the states again began to take part in the work and in some cases the U. S. Bureau of Fisheries had difficulty in keeping some of its territory.[1]

[1] Letters from Glen Leach and C. F. Culler, in file of La Crosse U. S. Fish and Wildlife Station, April 25, 1924 and July, 1925.

The *Fisheries Service Bulletin* for the years following 1919 is full of records of the great success of the rescue work all along the river. In November, 1919, the rescued fish numbered 150,000,000, *"every one of which would have been lost had it not been for activities of the Bureau's seining parties"* (Fisher. Serv. Bull., Nov., 1919). In 1921, C. F. Culler reported a total of 157,071,000 fish rescued up to September 30, with the water level lower than normal. The 1921 season seems to have been the peak, closing in November with a total of 176,000,000 fish rescued.

For many years the Bureau of Fisheries had been seeking special funds for the rescue work, but it was not until July, 1922, that a fund was made available by Congress for the establishment of a special rescue station and a permanent personnel. Clarence F. Culler was promoted from Superintendent of the Homer Station to Supervisor, Fish Rescue Station, Mississippi River Valley (Fisher. Serv. Bull., Aug., 1922). His headquarters remained at Homer for a time and later were moved to La Crosse. Mr. Culler, usually called "Cap," was more closely identified with the rescue work than any other person. He was, until his retirement in 1951, the oldest (in terms of service) employee of the Fish and Wildlife Service. He earned the nickname of "Paper Fish" because of voluminous reports he filed about the number of fish saved from the overflowed lands (La Crosse Tribune, July 25, 1948). Another version of the designation is that he always said "paper fish can't swim." Mr. Culler died on January 16, 1953.

It is natural that any work which reached such proportions as the rescuing of almost two hundred million fish annually would arouse a great deal of interest and some opposition. The sportsmen of the bordering states began to wonder if fish rightfully theirs were being sent to other parts of the country. In the reports of their work, the Bureau employees scrupulously mentioned the percentage of fish which were not returned to the Mississippi River channel. It was always a very small percentage. However, the complaints that many game fish were being removed and the coarse fish returned to the river seem to have been somewhat justified since the records show that from twenty to ninety-three per cent of the rescued "black bass" were transported to other waters. Mr. H. L. Canfield of La Crosse, Wisconsin says that complaints about rescue operations were invariably based on the number of "bass" which were taken from the river. He says that the rescue workers were given orders to return at least 50 per cent of these fish to "adjacent live waters." Mr. Canfield points out that the number of "bass" rescued was always very small because they usually returned to the river of their own volition and were seldom caught in the drying sloughs (H. L. Canfield, personal communication).

Mr. James Nevin, long time Superintendent of Fisheries in Wisconsin, aired his opinion of those who objected to the rescue work in

vigorous terms in the Biennial Report of the Fish Commissioners of Wisconsin (1897-98, pp. 32-33).

"The work of rescuing the bass from the sloughs should be continued each year, notwithstanding, it meets with objection from some people along the river. These people object to our taking the bass away from the sloughs and planting them in inland waters. They contend that they should be planted in the Mississippi River. They claim that we do not confine ourselves to taking the fish from the sloughs, but intimate that we steal them from the river for other people's benefit, etc. Last summer while we were doing this work at Prairie du Chien, a petition was circulated and a number of signatures secured, protesting against our taking the fish from the sloughs. As is usual in signing petitions, not a single signer on that petition took the trouble to try to verify the statements made in the petition or to ascertain whether they were true, which any of them could have done in two-hours time. The petition was presented to them and in as much as it contained nothing inimical to their individual interests they signed it as a personal favor to the party who circulated it; and in some instances, perhaps to get rid of him. If they had taken the trouble to investigate the matter they would be ashamed to have it said that their names were on the petition."

Apparently his irritation at the protests against rescue operations led him to seek other ways of providing fish for stocking, because in the same report he said that there were two small lakes in the park in Oshkosh which could be used to good advantage in the propagation of largemouth bass. Mr. Nevin said, *"I am satisfied that we can hatch and distribute more bass here than we have in the past and do the work for less money than it costs us to take them from the Mississippi River sloughs."* This statement constitutes an interesting reversal of opinion, because the small expense of the rescue operations as compared to the large cost of artificial propagation had always been one of the chief considerations favoring the rescue work. Nothing about the Oshkosh project appears in later reports by Mr. Nevin and the rescue work was continued throughout his period of service in Wisconsin. Possibly the rescue work proved cheaper after all.

Correspondence in the files of the U. S. Fish and Wildlife Station at La Crosse, Wisconsin, gives some idea of the criticisms and complaints directed at the rescue operations and the personnel of the U. S. Bureau of Fisheries. In 1923, a newspaperwoman in northern Iowa wrote to Mr. Culler, asking if it were true that rescue work had been stopped in the area of northern Iowa and southwestern Wisconsin because the crews were not getting any "black bass." And was it true that all of the "bass" which they had taken were removed from the river? Mr. Culler answered that about fifty per cent of the "bass" were

returned to the river and that *"the person who told you that not a hundred bass taken in the rescue work have been put back into the Mississippi this summer told you a positive untruth."* He said the criticism had been very strong because the local residents of Lynxville, Wisconsin, could **not** catch "black bass" in the river. He added that on one trip he had seen a Cedar Rapids resident fishing at Lynxville. In three days the Cedar Rapids man had caught 130 "black bass" weighing over one and one-half pounds each. He concluded that the Lynxville operation was stopped for lack of money, not of "bass."

In the summer of 1924, H. L. Canfield, Superintendent at the La Crosse Fish and Wildlife Station until 1949, called on a man who had registered a complaint that the Bureau was removing fish from the main channel of the river and not only from the bayous and sloughs. Mr. Canfield assured the complainant that the crews were not permitted to take fish from the channel. The man admitted that it was just hearsay and that perhaps the one who told him about it had been misinformed. He said he was anxious to have good fishing in the river. There was also opposition from groups who were interested in drainage of the bottom lands. Rescue crews were ordered off the land in some areas where the owners said that they would do all the rescue work necessary.

In 1924, and in the following years, the states again began to do rescue work, mainly as a way of securing fish to stock inland waters. The U. S. Bureau of Fisheries had difficulty in keeping good territory for its operations, but eventually an amicable agreement was worked out with the states concerned.

The development of the nine-foot channel and the consequent stabilization of the water level led to a great **curtailment** of the rescue operations. As the dams went in along the river, the rescue work became more restricted as to area, but more intensive. Even as early as 1910, **S.** P. Bartlett warned that it was imperative to increase the rescue work because the breeding grounds were being lessened by the growing number of levee districts (Bartlett, 1910). Attempts were made to supply some of the brood fish by raising them in sloughs in the Upper Mississippi River Wildlife and Fish Refuge. This refuge had been established in overflowed lands in Illinois, Iowa, Wisconsin, and Minnesota in 1924 (U. S. Bureau of Fisheries, 1928, viii).

In the *Fisheries Service Bulletin* for December, 1937, there was a note that the number of fish rescued in that year was less than normal:

> *"it is probable that this is the last season in which any appreciable quantity of fish can be salvaged from the drying sloughs in the upper Mississippi area because of the fact that the nine-foot channel development will provide stable water level.*
>
> *Sportsmen throughout the Middle West who have looked forward each year to receiving consignments of bass, sunfish,*

crappie, catfish, etc., from this source must look elsewhere in the immediate future. The Bureau of Fisheries is attempting to propagate fish in large, semi-controlled ponds within the refuge area, but this program will not be developed to completion for a number of years and the available facilities will not produce the millions of game and pan fish which the Mississippi River has hitherto furnished."

In the years for which it was possible to obtain records of the estimated numbers of fish caught, it appears that there were only five species which in any year comprised more than five per cent of the numbers of rescued fish. From 14 to 74 per cent of the fish were "catfish," including bullheads. "Sunfish" comprised 6 to 32 per cent of the annual catch and "crappies" varied from 3 to 37 per cent. Carp comprised from 0.6 to 39 per cent of the catch and "buffalo" from 0.6 to 16 per cent.

It is in relation to the extensive work in artificial propagation and planting of fish that the rescue work was most important. During the latter part of the nineteenth century and the first quarter of the twentieth, the growing of fish in hatcheries was the mainstay of the work in fish conservation. This is true to some extent even at the present time. Sportsmen's groups everywhere were clamoring for more fish in their favorite lakes and streams. Hatchery raised fish were very expensive and, under the most ideal conditions, provided only a fraction of the desired number. It is no wonder that the millions of young fish stranded in the bayous and sloughs attracted fish-culturists. Here was a practically inexhaustible supply of ready-hatched fish which could be collected at small cost compared to that of hatchery fish.

Dr. Hugh Smith (1920) pointed out that pond culture stations in the Mississippi Valley raised the same kinds of fish as were rescued. These fish are planted at "fingerling" length in streams and lakes. If the same number of fish as were rescued in 1919 had been raised in pond stations it would have required 345 pond stations and the actual cost of production would have been $860,000 (at $5.50 per 1,000). He figured that the additional stations necessary would have cost $12,000,000 to build and salaries and maintenance costs would have been over $2,000,000. The actual cost of salvage operations in 1919 was $31,000.

The Wisconsin State Conservation Commission (1949, p. 89) blamed some of their fishery problems upon the wide spread stocking of fish from the Mississippi River. They pointed out that between 1920 and 1925 tremendous numbers of rescued fish, mostly black crappies, were made available free to anyone. The black crappies, referred to in this 1947-48 Biennial Report as the "carp of the north," became extremely abundant in many of the northern Wisconsin lakes preventing the

growth of other fishes and often becoming stunted themselves due to competition.

The rescue operations were used as an aid in another phase of fish-cultural work, that of the artificial propagation of the pearly mussels, so important to the button industry in the Upper Mississippi River region. The rapid depletion of the supply of mussels led to many attempts to propagate them artificially. It was discovered that the larval mussels (glochidia) spent the first few weeks of their lives on the gills of fish as parasites. Many of the rescued fish in the holding ponds were infected with the glochidia before being released in the river. It was hoped that in this way new supplies of mussels would be established.

The only Federal fishery station which is now engaged in rescue work is the station at Guttenburg, Iowa. The work is done there only to provide brood stock for the hatcheries and to supply requests for specimens from the various large aquaria such as the Bureau's own aquarium in Washington, D. C., the Shedd Aquarium in Chicago, and the Dallas Aquarium (Eldon Saeugling, interview, May, 1950).

Some states now conduct rescue work mainly as a means of stocking their lakes and streams. Many of the former sloughs are now part of the main channel of the river, but new areas have been created by the flooding of other lands. Seining is very difficult in some of these regions because of submerged trees and brush which in former times had grown up. In 1944, E. B. Speaker, the Superintendent of Fisheries for Iowa at that time, reported that fish rescue work on the Mississippi depended largely on climatic conditions and the manipulation of the locks in the navigation pools. Fish were still being rescued in limited numbers at Lansing and Sabula, Iowa, in 1953.

Most fishery biologists now question that fish rescue is of any value in maintaining the fish populations in the river. The numbers rescued probably represent only a very small proportion of the fish in the river. The use of the rescued fish to stock lakes, ponds, and rivers is also of doubtful value, because stocking of lakes and streams does not necessarily improve the fishing. The most common cause of poor fishing in warm water lakes and ponds has usually been found to be that there are too many fish and additional stocking merely aggravates this condition. Many biologists believe that fish stocking is seldom needed except in new ponds and new artificial lakes (See Eschmeyer, R. W., 1949).

The Mississippi itself was always "the boss" in the rescue work. The fish-culturists of the states and the federal government often made the most careful plans for the rescue work only to have the plans completely ruined by water too low or too high for successful operations. The oft-repeated refrains "heavy rains made the rescue work impossible" or "water was too low," add a sad-humorous touch to the rescue story.

Iv

MUSSEL FISHING AND THE PEARL BUTTON INDUSTRY

The history of the mussel fishing and the pearl button industry on the upper Mississippi River is brief and colorful. It shows the same "feast or famine" philosophy which has characterized other industries in the United States which have depended upon the use of natural resources—for example: lumbering, mining, and other fisheries—whaling, sturgeon, and salmon.

Mussel fishing began on the river about 1889. In the previous year, a German button-cutter named J. F. Boepple had gone to Rock Island, Illinois, to investigate the reported mussel beds. He found that there were several species of commercial value in the river. Since they seemed to be particularly abundant near Muscatine, Iowa, he built the first button cutting plant at Muscatine. At the height of the pearl button industry, Muscatine was the undisputed button capital of the United States.

Within a decade after the first factory was built, there were signs of exhaustion of the beds in the stretch of the river near Muscatine. Two or three years were all that some of the beds lasted under the tremendous fishing pressure. A survey by the United States Bureau of Fisheries in 1898 (Smith, 1899) showed the large **mussel** bed in front of Muscatine could not stand the drain of another year's fishing. The large bed near New Boston, Illinois, twenty miles downstream from Muscatine, was becoming exhausted. When fishing began at New Boston, fishermen took from fifteen hundred to two thousand pounds of shells in a day. In 1898, a fisherman would have had difficulty in obtaining that quantity in a week. This decrease in a fisherman's take was partly due, however, to the fact that there were so many more fishermen in the later years. The operator of a ferry at New Boston in 1950 said that, when he was a boy, the clamming boats were lined up along the shore so solidly that one could walk from boat to boat for a distance of several blocks (Hartzell Odell, interview, August, 1950).

In 1897, it was reported that between Burlington and Clinton, Iowa (a distance of about eight miles), over three hundred persons were engaged in mussel fishing. In 1898, there were one thousand fishermen between Fort Madison and Sabula, Iowa. There were one hundred fishermen at Muscatine alone. As many as one hundred fifty to three hundred fishermen were sometimes fishing on one productive bed (Smith, 1899). In the winter, the number of "clammers" was aug-

mented by sawmill hands and other seasonal workers. Farmers found it difficult to get men to work on the farms, because former farmhands found clamming more interesting and profitable. The small amount of equipment needed for clamming and the fact that neither capital nor experience was necessary attracted many people to the river. Also, it was easy to dispose of the catch for cash. Sometimes at the beginning of the fishery, a man could make thirty dollars or more a week when a good bed was found. In 1899, the average earnings were much less than thirty dollars, probably below ten dollars per week. The lower income in 1899 was due to the increased number of fishermen, lower prices received for the catch, and the reduced numbers of the mussels (Smith, 1899, p. 293).

When it is realized that the first button factory was built in Muscatine in 1891, the **tremendous** speed with which the mussel fishery was depleted becomes most apparent. In 1899, the fishing grounds extended 167 miles from Fort Madison to Sabula, Iowa. In 1896, five hundred tons of shells were taken from a bed two miles long and a quarter of a mile wide. A bed near New Boston yielded 10,000 tons of shells in three years. Probably one hundred million mussels were contained in these hauls. The bed was about one and one-half miles long and sixty rods wide. There was another productive bed three or four miles below Clinton, Iowa. By 1898, the principal fishing was done between Davenport and Clinton. One of the most noted beds in the upper river was near Camanche, Iowa (Smith, 1899).

The mussel fishery was continually extended from the point of its origin near Muscatine. The rapidity of the spread was directly correlated with the rate of depletion of the central territory (Coker, 1921, p. 39). By 1902, the fishery had worked its way northward into Minnesota and Wisconsin and southward into Missouri. In 1899, it was the most important fishery in Wisconsin. Over sixteen million pounds of mussel shells were taken, valued at $66,110. There was a decline in the other types of fishing in Wisconsin as many of the regular fishermen turned to clamming (Townsend, 1902).

Dr. Hugh M. Smith (1899), who made the survey of the mussel fishing in 1898, said that the depletion of the beds was due to several practices: 1. The constant fishing, even during spawning season; 2. The taking of small mussels; 3. The wasteful taking of mussels, especially during the winter. Smith said, *"the history of the fishery up to this time (1898) shows the disregard for the future which has come to be regarded as characteristic of fishermen"* (Smith, 1899, p. 300).

A variety of equipment was used in mussel fishing when the industry began, ranging from hand rakes to a steam scow at Muscatine. In the spring of 1897, a very ingenious contrivance came into use. Because of its simplicity of operation and great effectiveness, the "crowfoot" dredge became the chief means of capture. It consists of an iron rod about six feet long and five-eighths of an inch wide. To this rod are

attached, at intervals of about six inches, series of four-pronged hooks made of stout wire. The hooks are made of two pieces of wire fastened together so that the prongs will be at right angles to each other. The hooks are four inches long and are fastened to the iron bar in strings containing two or three hooks. A strong piece of rope is tied at, or near, each end of the bar, forming a bridle to which is fastened the rope by which the dredge is pulled. This rope is about twenty-five feet long. The quantity of hooks varies with the length of the bar and the number of hooks in each string. A six-foot bar with three hooks to a string would have about thirty-nine hooks, and a seven and one-half foot bar with only two hooks to a string would have about forty-six hooks (Fig. 7).

In 1899, the average fisherman used two dredges valued at from $1.50 to $2.00 a pair. The dredges depended for their action on the habits of the mussels, which rest partly buried in the mud or sand with the open edge of their shells turned upstream. The two halves of the shell are separated to admit the water which carries food and oxygen to the mussels. When anything touches the shells, they close and cling tightly to any foreign object which is interposed between the valves. The fisherman threw the dredge overboard and then allowed the boat to drift slowly downstream. Sometimes the boat was aided by a partially submerged sail-like canvas attached to a wooden frame and operated from the stern of the boat as required by means of rope controls. This device was known among clammers as "the mule" (H. L. Canfield, personal communication). The dredge was drawn up and the mussels were removed from the prongs. Often, considerable force was required to detach them. To make the handling of the dredges easier, the fishermen placed upright forks on each side of the boat to hold the dredge-bar. One dredge was stripped of mussels while the other was being dragged along the bottom of the river (Smith, 1899).

Dr. Hugh Smith (1899) told of seeing sixty marketable mussels caught on thirty-nine hooks. He often saw clusters of shells on a string of hooks. On good, compact beds, a man could, in 1899, take eight hundred or a thousand pounds of "niggerheads" in a day. One man was reported to have taken twenty-two hundred pounds in one day, but the average was about five hundred pounds (Smith, 1899, p. 295).

A form of mussel fishing known as "polliwogging" was popular among young boys. The late Mr. W. E. Albert of Lansing, Iowa, told the writer that in his boyhood he and his friends indulged in this sport. They would dive to the bottom of the river and bring up shells in their hands. They sold the shells, but the main purpose of "polliwogging" was a search for pearls (Fig. 8).

Hand-raking and hand-picking were permitted in some areas, but were not too practical on the river, because of the depth of the water.

When the ice on the river became thick enough, mussel fishing was often done through the ice with "shoulder rakes" and "scissor rakes."

One man could rake six to eight hundred pounds of shells a day. They were emptied into box sleds and pulled over the ice to the weighing place.

Small, flat-bottomed boats, called "john boats" were used by the fishermen who operated the crowfoot rakes. These little boats, at 1898 prices, cost between $5.00 and $10.00. The fishermen who used dredges had barges or flat boats with enough deck room to operate the windlass and dredge, and a temporary cabin. The value of such a boat was about $20.00. Some clammers made their homes on houseboats moored near a good fishing ground. The average houseboat was worth about $200.00 (Smith, 1899).

The "cooking out" of the mussels was done in crude oblong tanks placed at convenient places on shore (Fig. 9). Fires were built under the tanks and the mussels were boiled for fifteen minutes. The boiling killed the mussels and made it easier to extract the meats. The shells were then loaded in sacks and taken to the button factories. Sometimes buyers from the factories bought the catch as soon as it was brought to shore. No commercial use was made of the meats. Farmers hauled away many to feed to their hogs and poultry and a few were used for fish bait. It was suggested that it might be possible to salt the meats and sell them to New England cod fishermen for bait, but as far as we know, that was never done (Smith, 1899).

When the mussel industry first started, the fishing was carried on from August to December, but later it was continued the year around. Ice fishing originated in the winter of 1896 and became popular. According to Dr. Smith (1899) the quality of the shells was best in cold weather, since they were not so brittle then. Other fishery workers have questioned this idea (Canfield and Greenbank, personal communications, 1952).

The supply of mussels was not replenished as fast as it was depleted since the mussels are extremely slow growing and the wasteful fishing methods did not give the population time to recuperate. A "niggerhead" mussel reaches a size of three inches in not less than ten years and, usually, it takes twelve years. A shell four and one-half inches in diameter is from fifteen to eighteen years old (Smith, 1899). Dr. Smith thought it doubtful that a mussel fishing ground could recover while commercially productive. As a result of his survey, he made the following recommendations (Smith, 1899, p. 314): 1. The gathering of small mussels should be prohibited and a minimum legal size should be prescribed; 2. Closed seasons should be fixed by law during the spawning season. The "niggerhead" clam was by far the most important species commercially and if this one alone were protected it would be sufficient. The closed season should be from January 1 to May 1; 3. Provisions should be made to prevent damage from sewage and factory refuse; 4. Prohibition of the shipment of shells to distant states might be considered, in order that local industries might be

fostered and the catch of mussels made no larger than could be utilized by the factories in the vicinity. (Dr. Smith noted that this view was held by persons "having pecuniary interests at stake."); 5. Button manufacturers should exercise greater care in utilizing shells in order to reduce waste of raw materials. These recommendations were not acted upon (Southall, 1925).

According to Smith (1899) there were over four hundred species of Unios found in the Mississippi, but not over forty-one of them were of any commercial importance. Most of the unsuitable ones had thin brittle shells, rough surfaces, or poor or uneven color. Many of the species to which Smith referred must have been varieties that cannot be considered as valid species, for Grier and Mueller (1922) list 63 species as authentically reported from the Mississippi River proper. Collections made in all suitable sites for mussels from Quincy, Illinois, to Point Au Sable, Minnesota, in Lake Pepin showed the presence of only 39 species in 1931 (van der Schalie and van der Schalie, 1950). The latter paper points out that if species normally found only in smaller rivers and species which are not now considered distinct are deleted from Grier and Mueller's list, there remain 38 species which correspond closely to the 1931 species list. The van der Schalies point out the desirability of an intensive study such as the 1931 survey to determine the changes which have taken place in the mussel fauna in the intervening years. The ten most important for the button industry were (Smith, 1899, p. 299):

1. The "niggerhead." This was by far the most important species.
2. The "yellow sand shell." A very valuable, but less abundant species than the "niggerhead."
3. The "black sand shell."
4. "Slough sand shell." A small species, rather rare, but very good for buttons. It was practically caught out in the region of Muscatine by 1898.
5. The "mucket." Also called "mouket" or "mougat." It made only second-class buttons.
6. The "deerhorn" or "buckhorn." This was one of the best mussels, but not abundant. The supply was uncertain and irregular.
7. The "butterfly." A rare, but very desirable mussel. Out of one hundred tons of miscellaneous shells from the Mississippi, there would probably be only a few hundred pounds of "butterffies."
8. The "blue point." Not too highly regarded, but sometimes used.
9. The "hatchet-back" or "hackle-back." Not highly regarded.
10. The "pocketbook" clams. Quite abundant and yielded a good button of medium thickness. Two species.

At intervals after 1899, other surveys were made of the mussel fishing and always the same conclusion was reached: the mussel beds were disappearing very rapidly. As has been noted earlier, the center of fishing shifted north and south from Muscatine. Lake Pepin, a widening in the Mississippi River between Minnesota and Wisconsin, became the greatest mussel fishing ground on the river. Lake Pepin is about twenty-eight miles long and two or three miles wide. It varies greatly in depth, being as much as fifty or sixty feet deep in some places. The bottom was largely sand and gravel, which made it an ideal spawning ground for fish and mussels. The early history of shelling on the lake shows that large catches were made. However, new methods of taking shells and the increase in the demand for them caused depletion before 1924 (Southall, 1925).

It became apparent that the mussel fishery was doomed unless some method of artificial propagation could be found, because depletion was occurring so much more rapidly than natural replacement could remedy. Studies made by Professor George Lefevre and Professor W. C. Curtis of the University of Missouri in association with the U. S. Bureau of Fisheries led to the development of a method of propagating mussels artificially.

Artificial propagation of mussels was based on the fact that almost all juvenile mussels (glochidia) spend one period in their lives as parasites on the gills of fish (Fig. 10). Attempts were made to artificially "infect" fish with the glochidia of commercially valuable mussels. At first the fish were infected indiscriminately and then released. This method was not too effective because of the high mortality of the glochidia (Howard, 1914).

Thaddeus Surber, working at the Fairport Biological Station where most of the mussel experiments were carried on, discovered, after intensive work on both natural and artificial infections, that certain species of glochidia would live only on certain species of fish. For example, the very valuable "niggerhead" mussel was found only on the **skipjack** or "river herring." Dr. Lefevre congratulated the Fairport workers on this important discovery. Surber also prepared a key to the glochidia (Dr. R. E. Coker, personal communication, 1951). For Surber's experiments, seining crews were sent out to obtain the fish to be infected with the glochidia and the gravid mussels were obtained from professional shellers on the river.

The importance which the U. S. Bureau of Fisheries attached to the precipitate depletion of the mussel beds was shown by the establishment of the Fairport Biological Station at Fairport, Iowa, in 1908. This station will be discussed in the next chapter.

Continuous experiments in propagating mussels were made and voluminous reports were written on the natural history of the **mussels**, parasites of the mussels, hosts of the glochidia of the various species, and the pearl button industry. Hardly a volume of the *Reports* of the

Commissioner of Fisheries or of the *Bulletin* of the U. S. Bureau of Fisheries appeared between 1898 and 1925 without some articles on the mussels of the Mississippi River.

In 1912, the propagation of the "fat mucket" was begun in Lake Pepin. Dr. A. D. Howard (1914) devised a method of holding the infected fish in floating crates with wooden floors to which the young mussels dropped when they fell from the fish and so were protected from their enemies. In August, 1916, eggs and glochidia were obtained from the muckets held in floating crates, the first successful effort after many trials. Glochidia transplanted to fish passed through their metamorphosis in less than twenty days. These young mussels represented a second generation reared in captivity (Fisheries Service Bulletin, Oct., 1916). Every year from 1912 until 1924, a steadily expanding program of propagation was carried on, but this program could not offset the destructive methods of gathering shells. The depletion grew steadily worse until in 1919 only two hundred tons of commercial shells were taken from all of Lake Pepin (Southall, 1925).

Dr. R. E. Coker, director of the Fairport Laboratory, concluded that propagation alone was not enough to restore the streams to their former productiveness. He, therefore, recommended a program of protection which would give streams periods of rest. He suggested dividing the Mississippi River into several sections, closing alternate sections for a period of years to all shelling operations. Then those sections would be opened and the others closed. Minnesota and Wisconsin acted concurrently to close certain parts of Lake Pepin. Closure went into effect March 20, 1919, and ended March 20, 1924, when those sections were opened and the alternate sections were closed (Southall, 1925).

T. K. Chamberlain made a survey of the mussel population of Lake Pepin in 1923, paying attention particularly to the percentage of "fat muckets," so that the benefit resulting from propagation might be ascertained. The data were of great importance, since the sections which had been closed were to be opened in 1924. In the summer of 1924, Southall (1925) made a similar survey. Chamberlain predicted that the two closed sections would show signs of recuperation and, in fact, the two sections produced two thousand tons during the shelling year of 1924.

In 1911, before the propagation program began, Shira recorded the percentage of "fat muckets" *in* Lake Pepin as being 36.5. The 1924 survey (Southall, 1925) showed 56.3 per cent "fat muckets" for the two closed sections. In the lake as a whole, the "fat muckets" made up 49.46 per cent of the mussels caught. The relative abundance of all other species remained about the same as in 1911.

The benefits of the closure program were quite apparent when the sections were opened in March, 1924. The record catch made at Pepin, Wisconsin, was 108 buckets in one day. A bucket of live mussels pro-

duced twenty-five pounds of cleaned shells. The average price paid for the shells was $40 per ton. Thus, the sheller netted $54. A fisherman told Southall that when the section was first opened to shelling, he averaged eighty buckets each day for a week. Almost equally heavy catches were reported from all quarters, but four months later (July) forty to sixty buckets constituted a day's work. Even such catches had not been common for years. The shellers said the fishing reminded them of the "good old days" when shelling first started on the lake.

Shelling in the section above Lake City, Minnesota, was not quite as successful as in the lower section. There, fishermen averaged about forty or fifty buckets a day. The season's catch in the upper section produced twenty-one carloads and the lower section, twenty-nine carloads. Each car averaged forty tons. The quantity of shells was certainly more than had been obtained any time in the preceding fifteen years (Southall, 1925). Although the clamming season was not half over when Southall made his survey in July, 1924, 30 per cent more mussels were taken than during the entire seasons of 1922 or 1923. Over one thousand tons at forty dollars per ton had been taken by eighty clammers between May 12 and July 31. Far more would have been taken except for the unusually windy weather.

Although after 1915 the Fairport Biological Station was developed as a fish cultural experiment station as well as a mussel propagation center, the artificial infection work continued to be the most important work carried on. Young mussels produced in troughs seemed to offer the best chance of success in the propagation program. By 1923, plans were under way for extensive rearing of them in that way. Darkened troughs produced twenty-five times as many juvenile mussels as those open to the light *(Fisheries Service Bulletin,* Feb. 1923). A battery of 140 troughs, each 16 feet long, 15 inches wide and 12 inches deep, was set up. The inside of each trough was painted black and a lid adjusted to shut out the light. "Black bass" were used, infected with the glochidia of the Lake Pepin or "fat mucket." The results were quite successful. Five hundred thousand mussels about one half inch in diameter were produced in the battery of troughs *(Fisheries Service Bulletin,* Oct. 1923).

As the fish-rescue work expanded, much of the mussel infection was carried on at the rescue stations at Homer and La Crosse, because they were much closer to the supply of fish than was Fairport. The cost of mussel propagation in 1919 was estimated at $0.0562 per thousand. Figuring mortality of glochidia at 27.4 per cent and survival of young mussels at 50 per cent, this would make the cost of a ton of marketable shells $5.65. The market price of Lake Pepin muckets in 1919 was $35 per ton. The National Association of Button Manufacturers provided seven agents to work with the rescue crews at Homer in October and November, 1920, in inoculating fish with glochidia. Six million fish were infected with 478,705,000 glochidia.

In 1926, at Fairport, the late Dr. M. M. Ellis, then of the University of Missouri, hatched freshwater mussels on artificial nutrient media for the first time. It was hoped that further experiments would lead to the development of methods of propagation that would make the use of the host fish unnecessary. The fishery experts apparently were concerned not only with the disappearance of the mussels, but with the depletion of the fish which served as hosts for the young mussels. The skipjack which served as host fish for the "niggerhead" mussel was no longer in the river above the Keokuk Dam.

Early in 1930, a new policy of pearl mussel conservation was announced by the Bureau of Fisheries. Because of the unfavorable effects of pollution in the Mississippi, the older method of infecting rescued fish was suspended. The Ellis method of artificial propagation was to be put on a producing basis, provided a supply of healthy mussel spawn was obtainable. Juvenile mussels from the hatchery were to be planted only where there was no pollution. A conference held in Washington, February 17 to 20, 1930, brought out some very significant facts which concerned the future of the mussel fishery *(Fisheries Service Bulletin,* March, 1930):

1. Statistics showed a startling decline in the mussels of the Upper Mississippi, particularly in Lake Pepin. In 1914-1915, Lake Pepin produced 3,000 to 4,000 tons of commercial shells; in 1929, not over 150 tons were produced. Only a few areas from New Boston to Pepin were still producing.
2. In most areas conditions were no longer suitable for mussel spawn. Apparently natural propagation had failed for several years.
3. Experiments showed that mussel spawn are sensitive to pollution. The Upper Mississippi was rapidly becoming polluted and threatened all aquatic life.
4. The proposed nine-foot channel from St. Paul to Quincy would make conditions worse for mussels.
5. The formerly productive beds were faced with exhaustion, and the Bureau was going to plant mussels only in unpolluted waters. It was possible that with careful controls artificial propagation could preserve the mussel resource.

In 1931, Dr. Ellis studied the natural replacement of mussels in the Mississippi River and found that there were no "niggerhead" mussels less than nine years old nor yellow sand shells under six years old. Dr. Ellis felt that erosion silt was the outstanding factor in producing the changes in river conditions. He warned that unless the erosion and pollution problems were solved, rapid reduction, amounting almost to extermination, of the mussels in some places could be expected (Ellis, 1931).

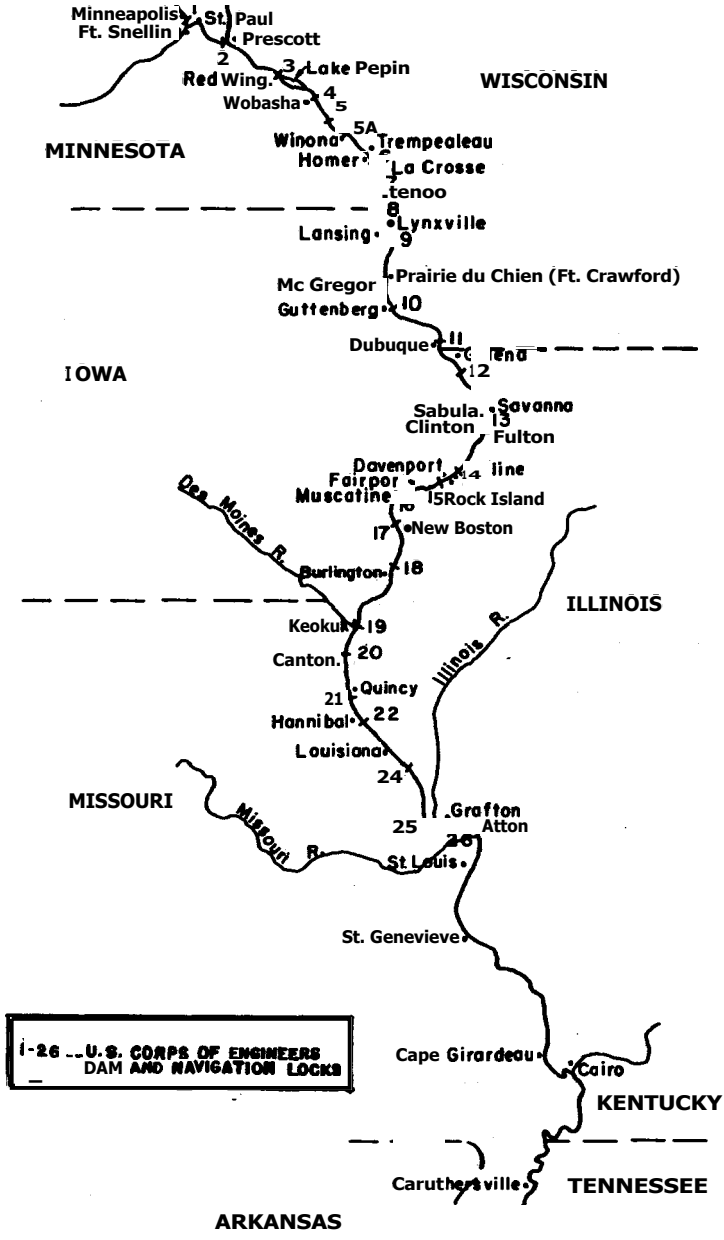

FIGURE 1.—Map of a portion of the Upper Mississippi River.

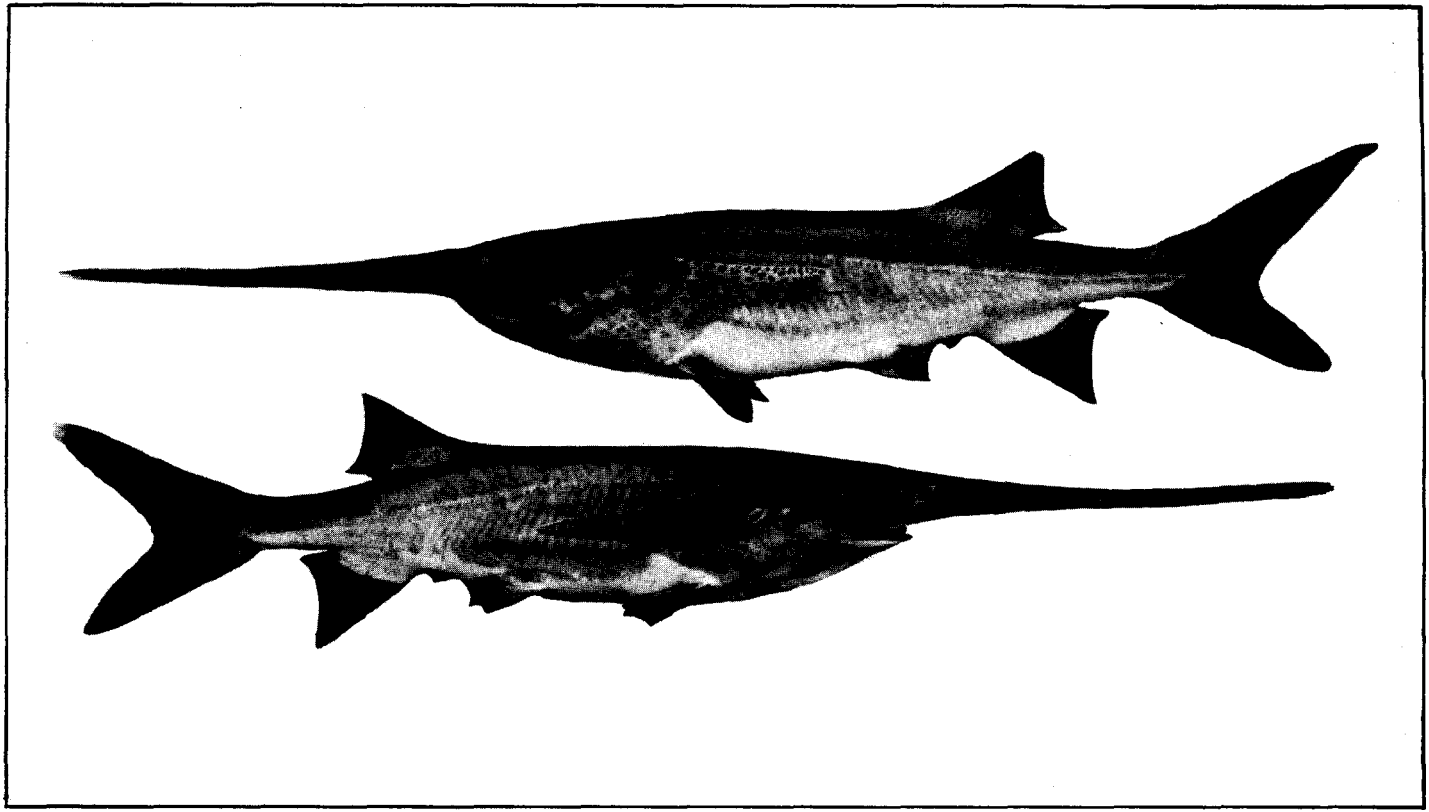

FIGURE 2.—Paddlefish.

Photo taken by Dr. *Nachtrieb* of the *University* of Minnesota at *Sebastopol* on Lake Pepin in 1900.

Courtesy of John Dobie, Minnesota Division of Game and Fish.

FIGURE **3.—Backwaters** of the Mississippi River, looking downstream over Sohokon Slough, Sohokon, Illinois.

Photo by Leo W. ***Gredell,*** Keokuk, Iowa.
Courtesy Illinois Conservation Department.

Courtesy Fred Brown, Muscatine, Iowa.

FIGURE 4.—Brown's Fishery, Muscatine, Iowa during the 1951 flood.

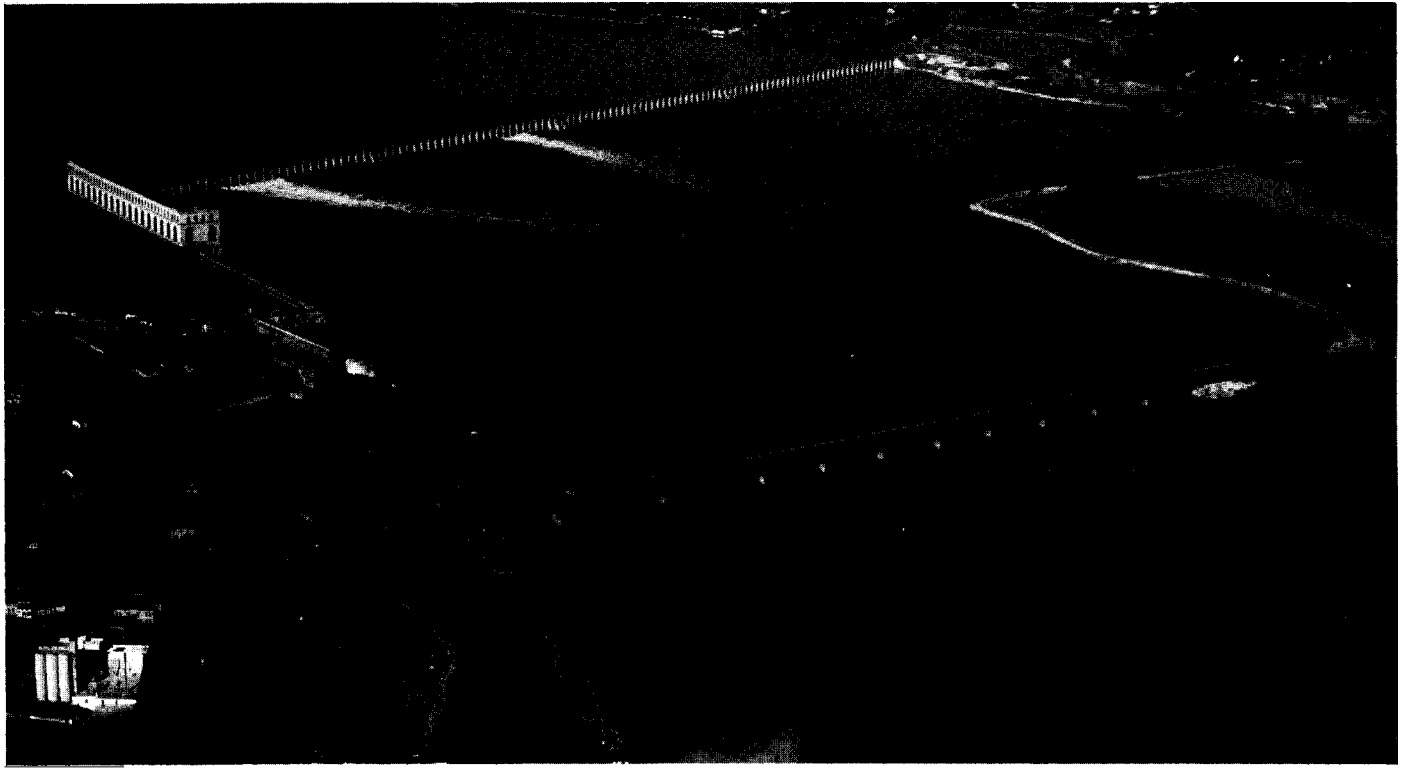

FIGURE 5.—Aerial view of Keokuk Dam.

Photo by Leo W. Gredell, Keokuk, Iowa.
Courtesy Illinois Conservation Department.

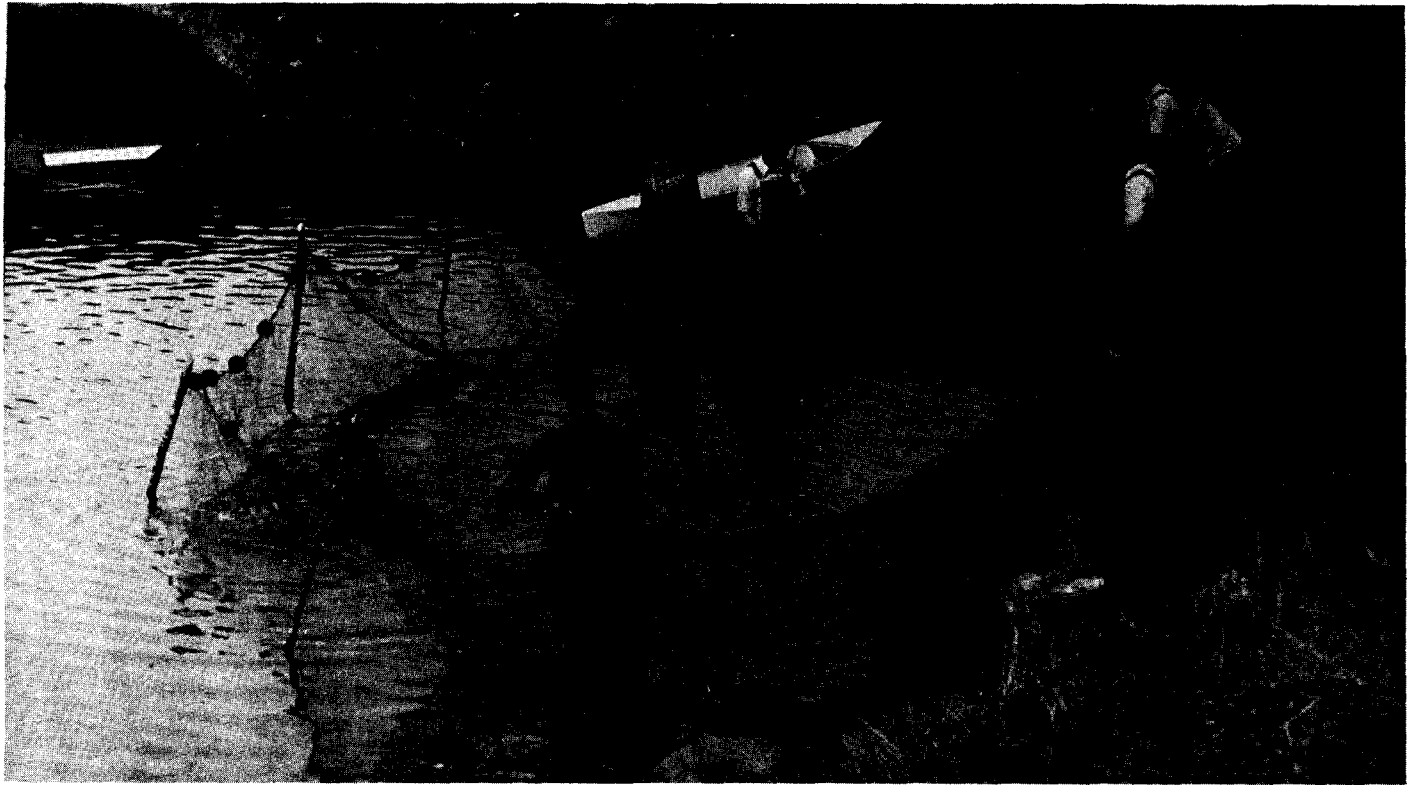

FIGURE 6.—Seining **broodstock** from a pond in flooded area near Genoa, Wisconsin. Part of the fish-rescue work program.

Courtesy U. S. *Fish* and Wildlife Service.

FIGURE 7.—Bar and crowfoot dredge on a boat for taking mussels.

Courtesy U. S. Fish and Wildlife Service.

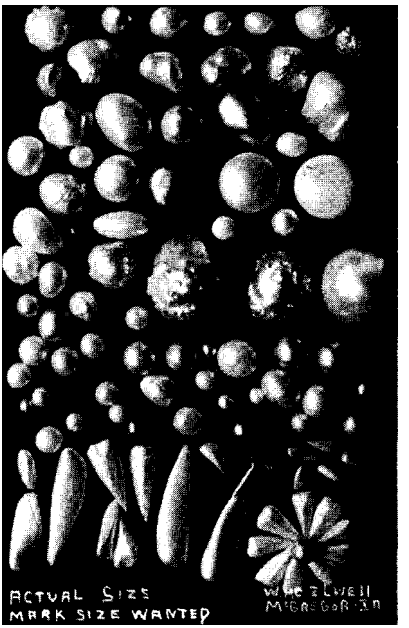

FIGURE 8.—Symmetrical pearls, baroque pearls, and pearl pieces from Mississippi River mussels.

Courtesy H. L. Canfield, La Crosse, Wisconsin.

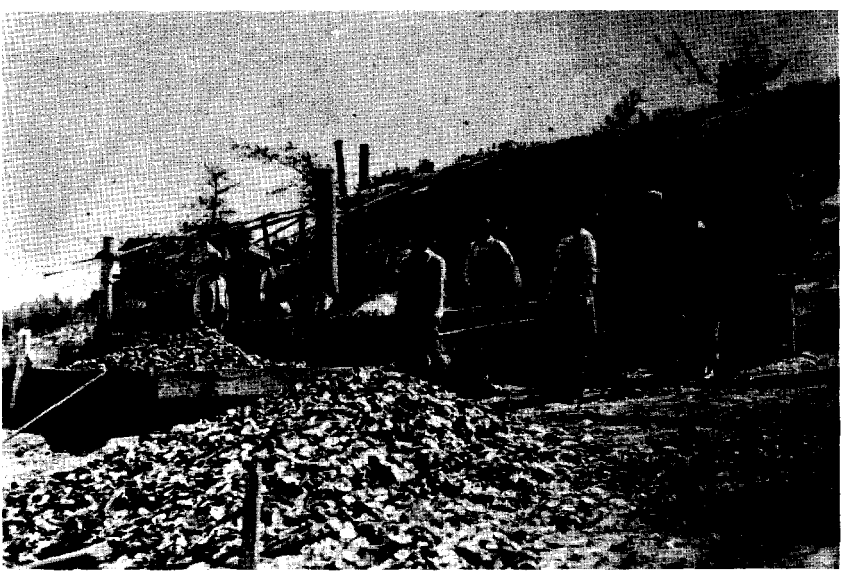

FIGURE 9.—The "cooking out" of mussel shells.

Photo by J. F. Boepple, November 9, 1908.

Courtesy U. S. Fishery Station, Fairport, Iowa.

FIGURE 10.—Natural infection of glochidia on the gill of freshwater drum.

Courtesy U. S. *Fishery* Station, Fairport, Iowa.

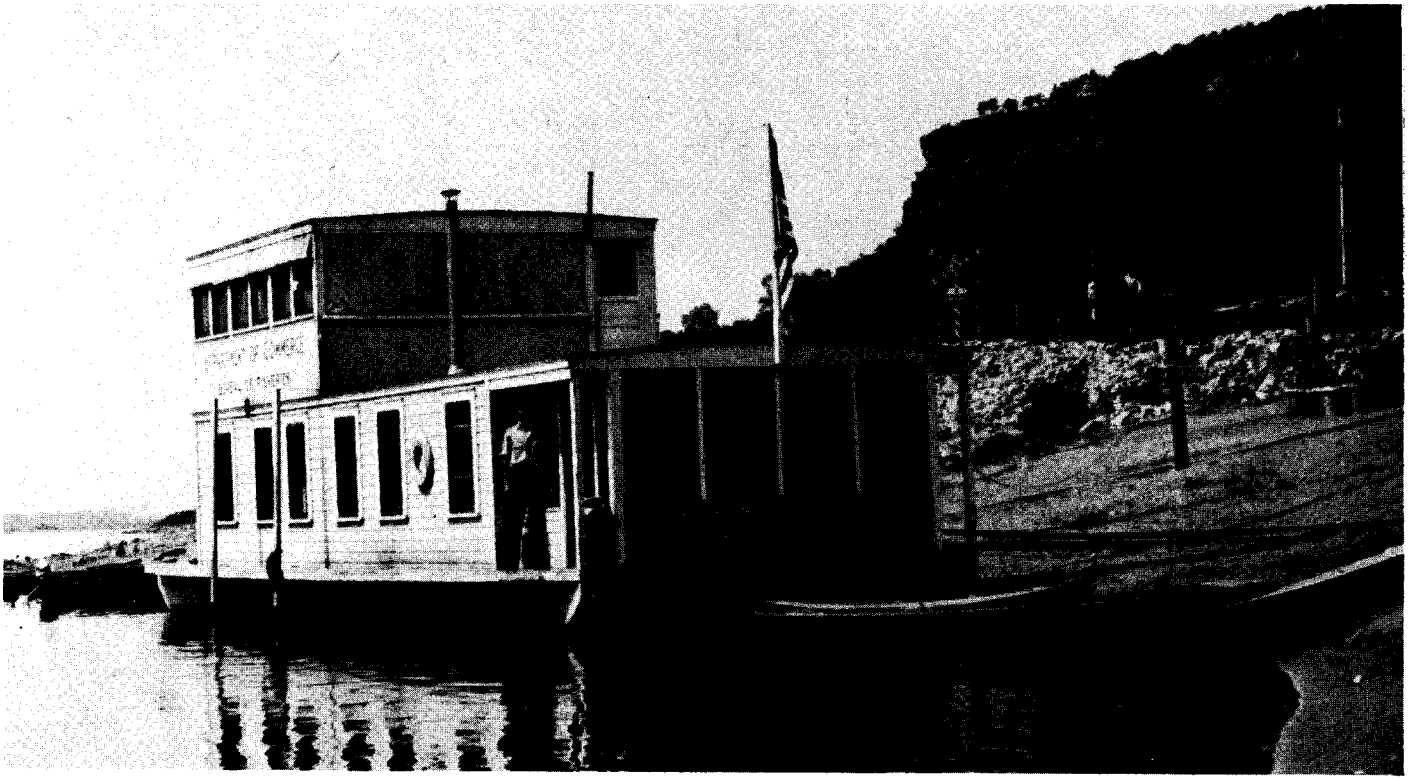

FIGURE 11.—Mr. Eugene Surber's houseboat and laboratory, Upper Mississippi Fish and Game Refuge, near Trempealeau, Wisconsin.

Photo by Elmer Higgins. Fish and Wildlife Service.

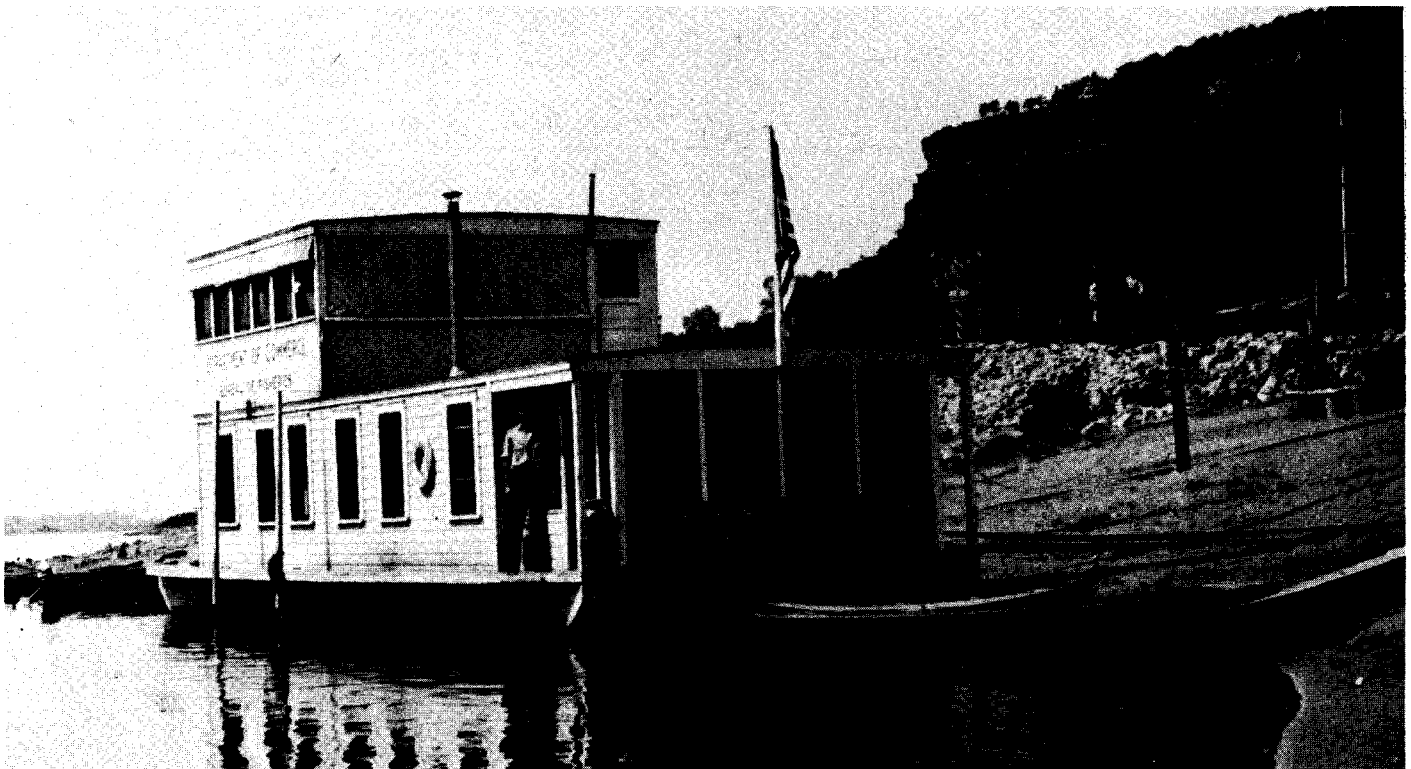

FIGURE 11.—Mr. Eugene Surber's houseboat and laboratory, Upper Mississippi Fish and Game Refuge, near Trempealeau, Wisconsin.

Photo by Elmer Higgins. Fish and Wildlife Service.

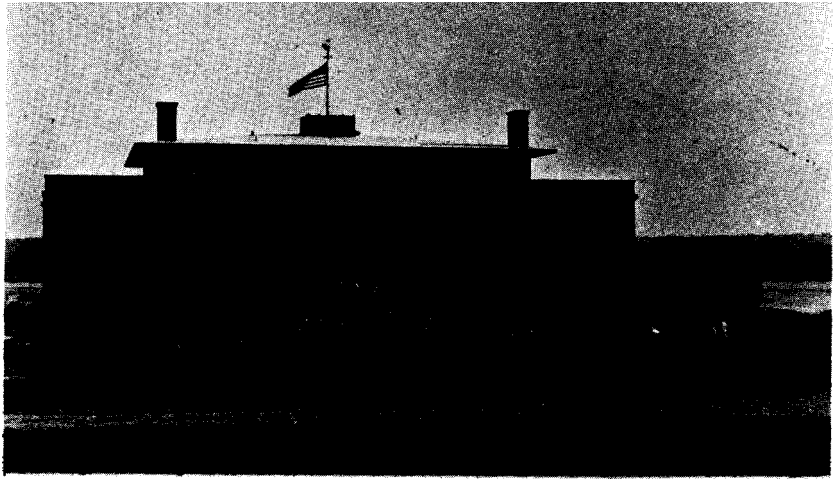

FIGURE 12.—Dedication ceremony at the new laboratory at Fairport, October 7, 1920.

Courtesy U. S. Fishery Station, Fairport, Iowa.

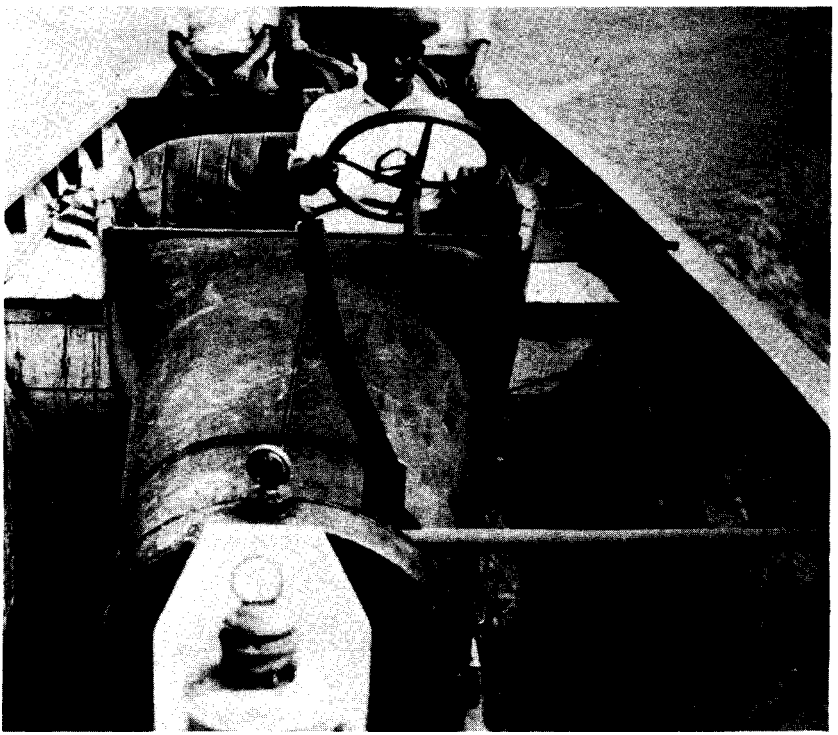

FIGURE 13.—Commercial fisherman and his boat, Louisiana, Missouri, 1930.

Courtesy Frank Marshall, Muscatine, Iowa.

Courtesy H. L. Canfield, La Crosse, Wisconsin.

FIGURE 14.—Seine haul, Bellevue, Iowa about 1920.

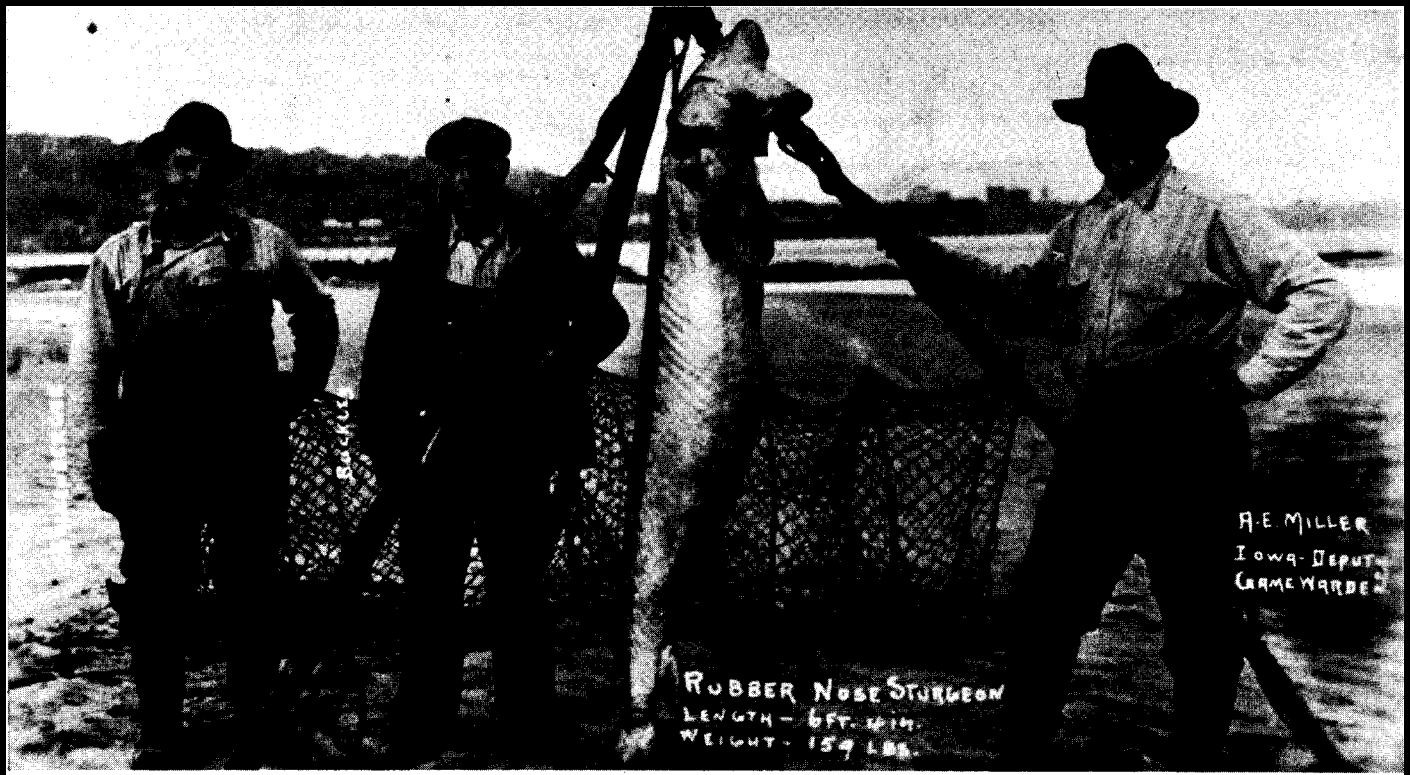

FIGURE 15.—"R[illegible]" lake sturgeon taken from Mississippi River at Muscatine, Iowa, October 3, 1931. Length of fish, 76 inches. Weight, 159 pounds.

Courtesy Iowa Conservation Department.

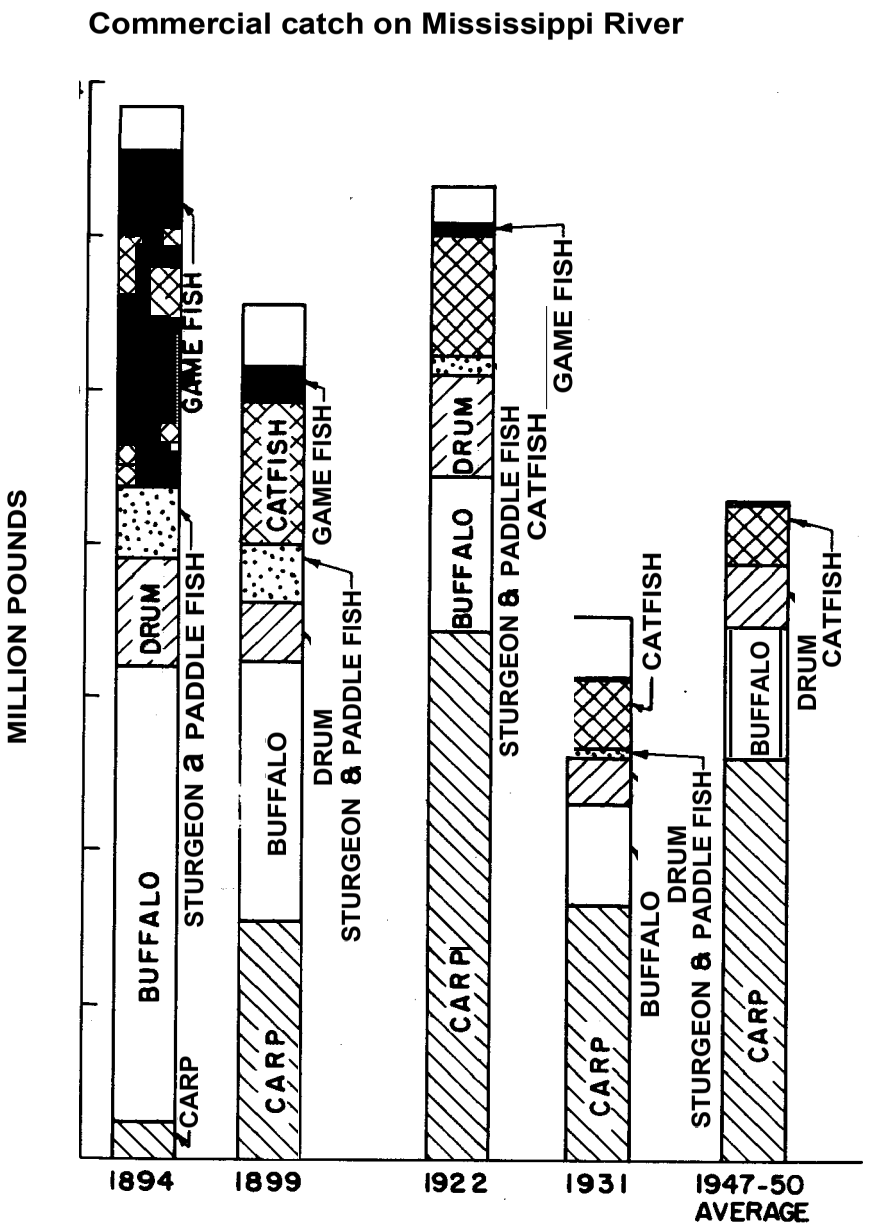

FIGURE 16.—Commercial catch on the Mississippi River.

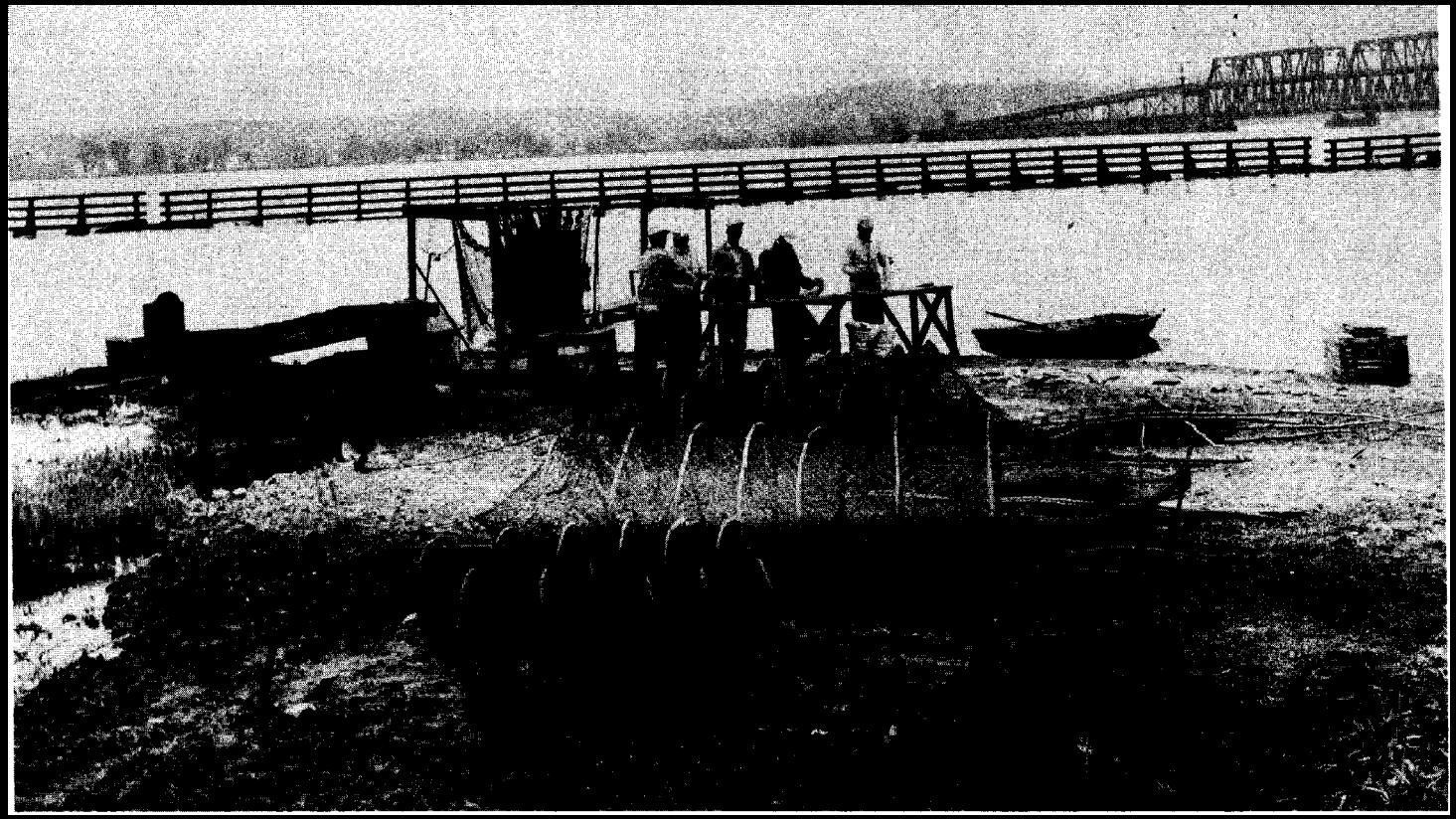

FIGURE 17.—Commercial fishing by prisoners at Iowa State Penitentiary. Fort Madison, Iowa.

Courtesy Warden Percy Lainson, Fort Madison, Iowa.

FIGURE 18.—Lifting fyke nets on the Mississippi River.

Photo by Don Woolridge
Courtesy Missouri Conservation Commission.

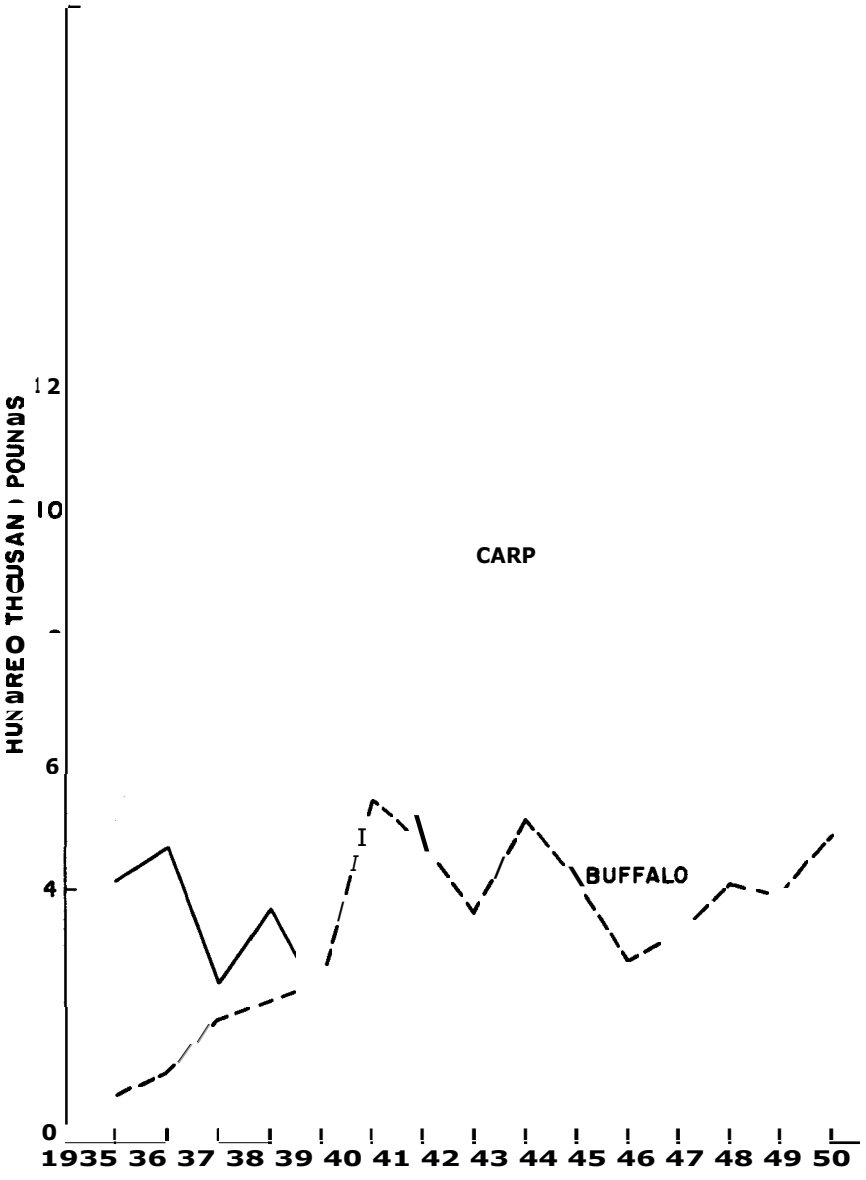

FIGURE 19.—Annual [illegible] Ehrlich Fishery, Lansing, Iowa.

Annual poundage of certain species handled at Ehrlich Fishery, Lansing, Iowa, showing changes in species composition.

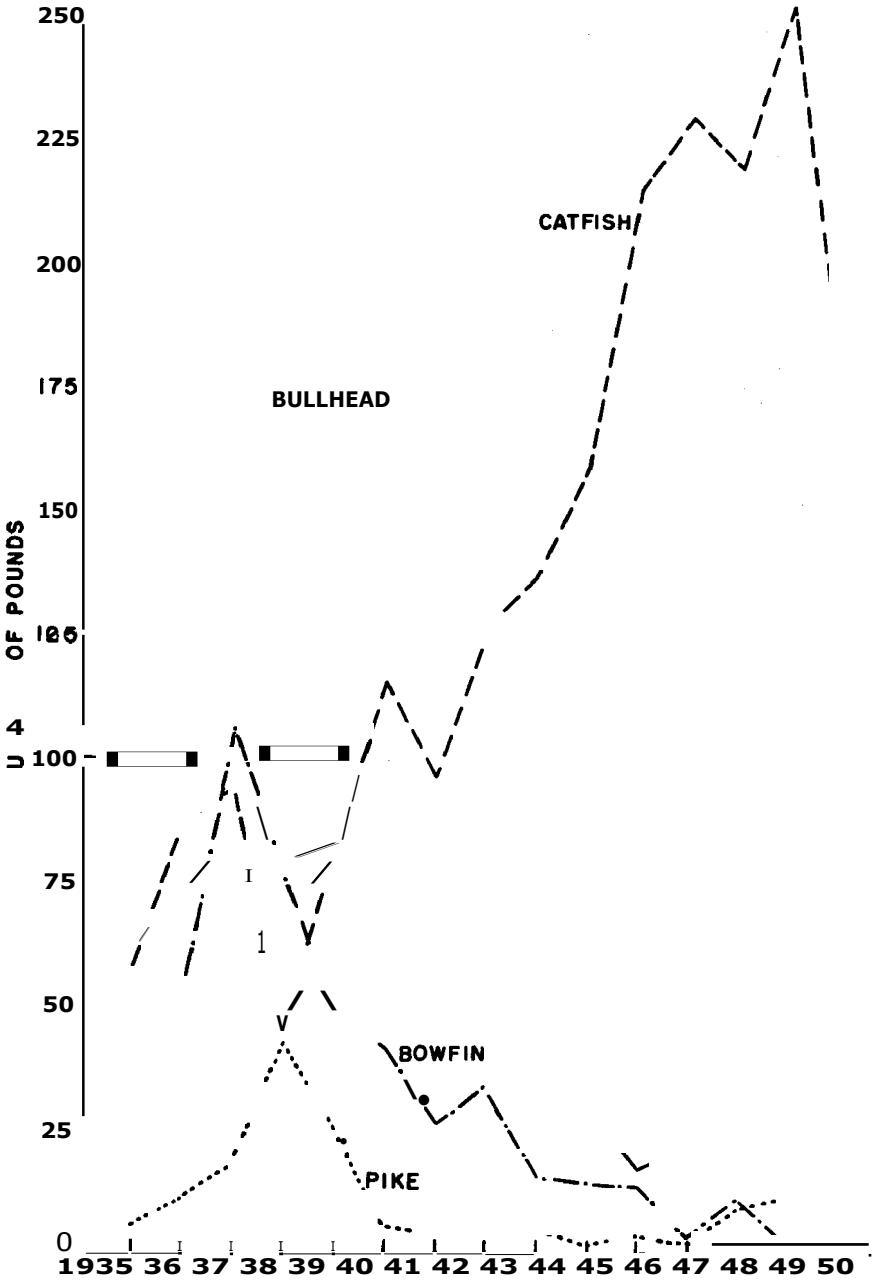

FIGURE 20.—A[illegible] E[illegible] F[illegible], L[illegible], I[illegible].

FIGURE 21.—Dr. Robert E. Coker, first director of the Fairport Biological Station.

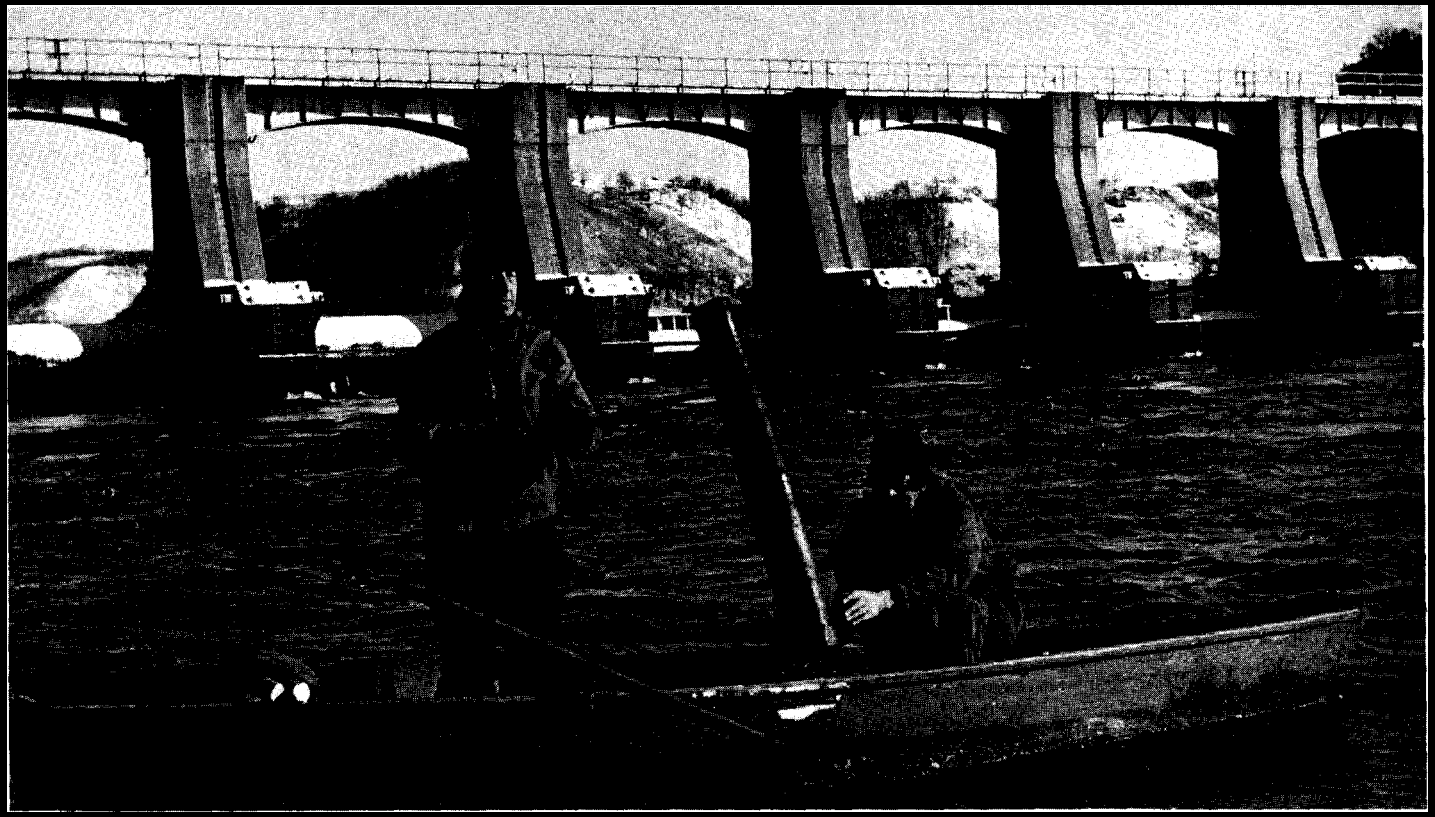

FIGURE 22.—Winter "pike" fishing below the Lynxville Dam, near Harper's Ferry, Iowa.

Courtesy State Conservation Commission of Iowa.

As a result of Dr. Ellis's findings, the Bureau of Fisheries again changed its policy regarding mussel fishing. The Bureau recommended the elimination of restrictions on the taking of mussel shells in the waters of the Upper Mississippi River. This recommendation was made *"in accordance with the true concept of conservation as wise use of natural resources rather than simply 'hoarding' or protecting." (Fisheries Service Bulletin,* February, 1932). The action was taken because it had become apparent that the methods of propagation which Dr. Ellis had perfected would be unavailing in maintaining the supply in waters where natural conditions had been so altered.

The only hope for the continuance of the freshwater pearl button industry seemed to lie in the artificial propagation of mussels under controlled water conditions on "farms." The Bureau undertook experiments at its Fort Worth, Texas, hatchery to determine the practicability of growing mussels on a large scale in raceways and pools *(Fisheries Service Bulletin,* Feb., 1932). The results were apparently unsuccessful as no further mention of the project was found. Experiments are still being conducted on the artificial propagation of mussels in streams (Jones, 1950).

The history of the pearl button manufacturing industry parallels the history of the mussel fishery. In fact, it was the button industry which was responsible for the fishery and for the emphasis upon the conservation of the resource. As Dr. R. E. Coker expressed it (Coker, Shira, Clark, and Howard, 1922): *"The development of the freshwater pearl button industry has furnished an effective stimulus to biological studies of high scientific interest and import . . . ."* In recent years Dr. Coker has re-emphasized the importance of the cooperation of the button manufacturers (Personal communication, 1952).

The pearl button industry was started in Muscatine, Iowa, in 1891, by J. F. Boepple who had been a horn button-turner in Hamburg, Germany (Haffner, 1928). In a letter to the *Muscatine Journal,* October 4, 1900, Boepple said that he came to Rock Island, Illinois, in 1888, looking for shells for buttons and ornaments. He heard about the shell beds at Muscatine and started cutting button "blanks" there. The McKinley tariff on pearl buttons made it profitable to manufacture them. In fact, Mr. Boepple said, the tariff made buttons so valuable that people started putting pennies in the collection plate!

Boepple was handicapped by his small knowledge of English, and, according to his account, an unscrupulous partner gave valuable information to other machinists, and button plants began to spring up all over the Mississippi Valley.

The rapid growth of the button industry is shown in the statistics published in 1902 (Townsend, 1902). In 1899, there were sixty button factories in Illinois, Missouri, Iowa, and Wisconsin. Forty-one of these factories were in Iowa, eleven in Illinois, six in Missouri, and two in

Wisconsin. A total of 1,917 persons were employed; 1,455 of them in Iowa.

Mussel shells totaling 11,300 tons and valued at $139,155 were used in 1899. Button "blanks" totaling 3,146,413 gross were cut and 1,073,553 gross of finished buttons were manufactured. The "blanks" were valued at $479,931 and the finished buttons at $336,504 (Townsend, 1902, p. 670). The fact that the finished buttons had a smaller value than the blanks might at first seem to be incongruous. Large numbers of the blanks were shipped to other factories for finishing, and only buttons finished in the Mississippi River factories were included in the "finished button" statistics of this report. In 1894, just five years earlier, 195,000 pounds (97.75 tons) of shells were taken and valued at $2,737 (Coker, 1921).

The button manufacturers of Muscatine suffered a decline in their prosperity around 1900. They blamed the decline on the fact that there were too many manufacturers. The market was overstocked with button blanks and 200,000 gross were stocked up without a market. A prominent manufacturer warned "Muscatine's army of intelligent button cutters" that the button industry was born of McKinley Republicanism and could live only under the Republican Party (*Muscatine Journal,* Sept. 26, 1900):

> *"Nothing would blight the button business more quickly or effectively than the ascendancy to power of the Democrats. In fact . . . if Bryan should be elected this, fall, everything in our factories would drop 20 per cent that minute. We could not help ourselves."*

The fishermen were apparently the losers in the scramble to build more button plants. In spite of the increased number of markets, by October, 1900, shells were bringing a price that suited the buyer (*Muscatine Journal,* October 4, 1900). Montpelier, a little town near Muscatine, had already gone through its boom of shelling by 1900. Only a few men still followed the rather uncertain calling. By the end of the year (1900) no resident was actively engaged in shelling, nor had been for four months.

The uncertainty of shelling as an occupation is shown by the statistics on mussel shells in the Biennial Reports of the Fish and Game Warden of Iowa in the 1920's:

Year	Pounds	Value
1920	1,866,580	$54,294.71
1921	1,043,894	13,130.76
1922	1,002,355	16,807.80
1923	1,424,933	31,161.85
1924	1,156,657	21,632.55
1925	1,144,687	45,432.10

It is clear that there was little relationship between the number of shells caught and their value in the market. It was plainly true in 1920, as it was in 1900, that shells brought a price which suited the buyer.

In addition to the market for shells, there was a considerable trade in freshwater pearls, but this was not organized. Most "pearlers" were farm laborers and adventurers who did not stay in one place very long. Freshwater pearls were considered inferior to oyster pearls, but individual jewels sold for several hundred dollars. "Sweet water" pearls were sold even in Europe with some success. Many eastern jewelry houses had pearl buyers in Muscatine in 1900. There were always pearl buyers staying in the Lansing Hotel at Lansing, Iowa during the clamming season. In 1899, the total value of the mussel fishery in Iowa was $97,449. Of this, $3,617 represented the value of the pearls and $1,617 were derived from baroque pearls (irregular stones sometimes known as "slugs") (Townsend, 1902).

There are still a number of factories in Muscatine, but these must ship in most of the shells they use from streams in Tennessee and Arkansas. A small factory in Louisiana, Missouri, the Nord—Buffum Button Company, was, in the summer of 1950, finishing buttons from blanks bought at another plant and polishing large shells to be used as baking dishes. A few years ago, experiments had been made at this plant in manufacturing casein buttons. Newer methods and materials have made the casein plastic buttons obsolete. This plant, founded in 1902, has been in the same family for many years.

There is still some clamming along the Mississippi River, mostly for trot-line bait. Barnickol and Starrett (1951) reported that during a survey conducted from Dubuque, Iowa to Caruthersville, Missouri, in 1946, they observed no activity in mussel fishing below Muscatine. When the weather was favorable, twelve or fifteen shell-fishing boats could be seen from the Muscatine waterfront. The survey party noted some shelling activity as far north as Clinton, Iowa.

The piles of shells which can be seen along the Mississippi River, and the abandoned buildings which once housed button factories show how the industry had a brief prosperity and then, in most places, disappeared as the shells disappeared from the river.

V

THE FAIRPORT BIOLOGICAL STATION

The idea of building a freshwater biological laboratory on the Mississippi River grew out of the work of Dr. Curtis and Dr. Lefevre on the artificial propagation of mussels. However, it was not intended that Fairport should be merely a propagation center. The men who were first concerned in the establishment of the station—Dr. W. C. Curtis, Dr. George Lefevre, and Dr. Barton Evermann—hoped that it would be a biological center for the Mississippi Basin, something like Woods Hole, Massachusetts or Beaufort, North Carolina (Coker, personal communication, 1951). Funds for the building of a station at Fairport, Iowa, were appropriated in 1908. When Dr. R. E. Coker (Fig. 21) arrived as first director on January 3, 1910, a little work had been done on the foundation of the first building, which was the boiler and pump house. Dr. Coker wrote that *"it was my responsibility to lay out the general design, to get the scientific and practical work going, and to set the plans and policies of operation and development, first along the general and excellent lines envisioned by those concerned with the movement before I came into the picture, notably Drs. Lefevre, Curtis, and Dr. Evermann."*

United States Commissioner of Fisheries George M. Bowers in his annual report for 1909 stated that various sites had been investigated for the newly authorized biological laboratory including Muscatine, Fairport, Davenport, Clinton, and Camanche, Iowa; La Crosse, Wisconsin; Winona and Homer, Minnesota; Rock Island, Illinois, and Terre Haute and Vincennes, Indiana.

The Fairport Station was beautifully located on the Mississippi River between Davenport and Muscatine. The grounds comprised sixty acres. When completed, there were several buildings, including a well equipped laboratory. Experimental ponds were constructed on the grounds. Across the road from the laboratory were several houses used by staff members and their families. Three summer cottages were available for investigators who came just for the summer season and brought their families with them.

The main laboratory building was constructed in 1912 and 1913, and opened for general investigations on June 15, 1914. A formal dedication was held August 4, 1914, with the attendance of some 5,000 persons. A tablet was presented at the ceremonies in memory of J. F. Boepple, *"founder of the fresh-water pearl button industry and late shell expert of this station." (Coker,* 1916, p. 388).

The first investigations at the station were started in June, 1910, and dealt with various mussel problems. The propagation of mussels on a practical scale was started in 1912. Much of the research and propagation of mussels described in the previous chapter centered at the Fairport Biological Station. Research was not limited to mussels, however, and for many years Fairport was the principal center of freshwater fisheries research.

The station had a complete outfit of simple button-making machinery of the old type, formerly used by J. F. Boepple, to make commercial tests of shells and buttons (Coker, 1916, p. 392).

In 1915, Dr. Coker went to Washington, D. C. as Assistant in Charge of Scientific Inquiry of the Bureau of Fisheries, and A. F. Shira was appointed as director.

In 1915, new ponds were constructed for experiments in fish culture. The first attempts to rear "buffalofish" were made by Harry Canfield, Superintendent at Fairport. The eggs were hatched in jars (Canfield, 1918). About 1,723,625 fry were produced *(Fisheries Service Bulletin,* No. 4, 1915). In addition to this experiment, the first successful rearing of "buffalofish" fry in ponds was achieved.

Fish-culturists had found it impossible to make channel catfish *(Ictalurus punctatus)* reproduce in confinement. Mr. Canfield undertook to solve this problem at Fairport. Dr. Coker remembered an experience he had had with hook and line fishing in a Michigan lake. He had pulled up a broken pitcher in which there was a "catfish" and a nest of eggs. He suggested to Mr. Canfield that he supply his ponds with the equivalent of a number of pitchers. Mr. Canfield used lengths of hollow tile pushed into the sides of the ponds. *"The catfish took to them in short order and success was attained in highly satisfactory degree—for the first time for that fish"* (Coker, personal communication, 1951).

The fish propagation program at Fairport had two main aspects, the production of fish for lakes and streams of the midwest and the development of fish cultural techniques. Some of the early experiments on the fertilization of ponds to increase fish production were carried on at Fairport. Experiments were also conducted on the propagation of freshwater turtles, lake sturgeon, and paddlefish. The propagation of largemouth bass received particular study in the late 1920's and early 1930's under A. H. Wiebe and Dr. H. S. Davis. Since 1932, the investigational work at Fairport has been relatively insignificant, with practically all of the attention being devoted to straight production of fish for stocking purposes. For a period of about 20 years, however, Fairport was probably the most important center of freshwater fish culture investigations.

Scientists from the colleges and universities were encourged to come to Fairport during the summer to work on their own research or to pursue problems which the resident biologists at Fairport had uncov-

ered. Some of the investigators brought their families, but most of them did not. There were three cottages available on the station grounds for families of summer personnel. The other workers roomed with the permanent staff or in the village of Fairport. Recreation consisted of fishing, hiking in the bottomlands, picnicking, swimming, and an occasional dancing party in the laboratory. Occasional trips were made to Muscatine only nine miles away. Time for recreation was limited because of the long hours spent in the laboratory and in the field (Canfield, personal communication, 1951). The library was extensive, containing exchange publications from research institutions in the United States and foreign countries.

Some idea of the type of work which these summer special investigators did can be secured from a list of the investigators in the summer of 1916, published in the *Fisheries Service Bulletin,* for August, 1916:

Dr. C. B. Wilson, Massachusetts State Normal, working on parasitic copepods.

Dr. D. Wright Wilson of Johns Hopkins, working on blood chemistry, aided by Edward F. Adolph of Harvard University.

Professor H. S. Davis, University of Florida, working on protozoan parasites. (In 1930, Dr. Davis came back in charge of the fish propagation work at Fairport. In 1953, he published the book, "Culture and Diseases of Game Fishes", drawing upon his experiences at Fairport and elsewhere for the U. S. Bureau of Fisheries.)

Professor F. J. Abbott, Washington University, St. Louis, studying the relationships of fish by blood precipitates.

Dr. A. R. Koontz, Johns Hopkins, rearing of glochidia on artificial media.

H. E. Schraddieck, Cornell University, H. B. Bigelow of Robinson, Iowa, and George B. Lay of the University of North Carolina, studying fish foods.

Many of the other special investigators who came in other years are well known in scientific circles: *e.g.* Emmeline Moore, Professor of Botany from Vassar who later became head of research for the New York State Conservation Department, E. P. Churchill of Johns Hopkins and University of South Dakota, Professor C. W. Green of the University of Missouri, Dr. A. S. Pearse, Dr. J. F. Mueller, and Dr. M. M. Ellis.

Many of those who got their early biological research experience as Scientific Aids at Fairport later became outstanding biologists in the Bureau of Fisheries or in colleges: *e.g.* A. H. Wiebe, Paul S. Galtsoff, Thomas K. Chamberlain, Raymond L. Barney, A. D. Howard, H. W. Clark, R. A. Muttkowski, and Thaddeus Surber. The Fairport Station has had a considerable effect upon fishery biology in the training which it gave.

During the first World War, work was done at Fairport to encourage the use of "rough fish" for food. J. B. Southall conducted experi-

ments on smoking fish, with excellent results. He constructed a smokehouse near the Bristol fisheries (now the Brown Fishery) in Muscatine where he demonstrated the smoking of bowfin or "dogfish." He also devised a bowfin salad which was served at a businessmen's luncheon in Muscatine *(Fishery Service Bulletin,* Sept., 1917). Mr. Southall and Miss Olive Green of the University of Illinois demonstrated smoking and cooking fish along the Mississippi, Illinois, and Ohio Rivers *(Fishery Service Bulletin,* November, 1917).

In the early morning of December 20, 1917, the main laboratory at Fairport was destroyed by fire. Only furniture and some records were saved. A great many of Surber's mussel records were lost. Although the loss of the library and the laboratory equipment was a tremendous handicap to the work at the station, research seemed to continue unabated. A temporary laboratory building was used. It had been one of the original buildings at Fairport and provided crowded quarters.

An appropriation of $80,000 for the rebuilding of the Fairport Laboratory was made by Congress in the spring of 1918 *(Fishery Service Bulletin,* April, 1918). The first bids which were received had to be rejected because they exceeded the appropriation. However, by March 1920, John B. Southall, superintendent of construction at Fairport, reported that the new fireproof laboratory was under cover and some of the concrete floors and walls were in.

The new building was constructed of concrete, stone, and brick. It was about one hundred by fifty feet, three stories high. There were accommodations for sixteen investigators, with possibility of increased space. A well lighted library, a chemical laboratory, a photographic room, a museum, a mess hall and kitchen, and tank and aquarium rooms were all included in the building.

On October 7, 1920, the new laboratory was dedicated (Fig. 12). Representatives of state universities, the pearl button industry, and the U. S. Bureau of Fisheries were present. The Assistant Secretary of Commerce and the congressman from the Fairport district were in attendance.

At the dedication ceremonies, Albert F. Dawson, former member of Congress from the Fairport district, acted as chairman. The building was presented to the Department of Commerce by the architect, Professor James M. White. On behalf of the Department, Assistant Secretary of Commerce Edwin F. Sweet accepted the laboratory and gave an address on "Federal and State Responsibility for Maintaining Resources of Interstate Waters". There were several other speeches delivered, including those by Dr. Hugh M. Smith, Commissioner of Fisheries and Dr. Edward A. Birge, President of the University of Wisconsin.

The day after the dedication, the first of a series of conferences was held in the new laboratory. The chairman was Professor Stephen A. Forbes of the University of Illinois and the Illinois Natural History

Survey. The principal address was given by Professor James G. Needham of Cornell University on "The Biological Resources of our Inland Waters" *(Fishery Service Bulletin,* November, 1920). Fairport became a popular meeting place for conferences on biology. One of the most important was held there in June, 1921. One hundred twelve delegates attended from Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, New York, Ohio, Pennsylvania, South Dakota, Wisconsin, and the District of Columbia. They included fishermen, fish dealers, button manufacturers, engineers, sanitarians, conservationists, state and national fishery officials, and biologists. The conference committee was composed of Dr. R. E. Coker, then Assistant in charge of Scientific Inquiry of the Bureau of Fisheries, V. E. Shelford, University of Illinois, J. E. Krouse, a button manufacturer of Davenport, A. S. Pearse, University of Wisconsin, F. A. Stromsten, University of Iowa, and R. L. Barney, Director at Fairport. Professor Stephen A. Forbes of the Illinois Natural History Survey was chairman of the conference *(Fishery Service Bulletins,* May, June, and July, 1921). The large number of delegates and the wide area represented by them and the distinction of the committee which planned the conference show the importance which the Fairport laboratory had in the field of fisheries research.

Austin F. Shira resigned as Director of the Station in September, 1920 and Raymond **L.** Barney came from the Beaufort (N. Ca.) Station as the new Director. Thomas K. Chamberlain became Director in 1924. In the post-war years the emphasis was placed more upon the fish cultural aspects of the Station. Dr. Max M. Ellis, of the University of Missouri, was placed in charge of the research in 1930, with T. K. Chamberlain as first assistant, in a final effort to save the mussel resources which had meant so much to the button industry. After the nine-foot channel was established, hopes for a return of the mussel resources were largely abandoned. The annual report on Progress in Biological Inquiries, 1933, states (Higgins, 1936, p. 379) : *"Research activities at the Fairport (Iowa) laboratory, equipped for the investigation of fresh-water biology, have been entirely discontinued, owing chiefly to a lack of sufficient funds. The station is operated for the present by the Division of Fish Culture solely for the culture of warm-water pond fishes."* The fish propagation work has continued to the present. The laboratory building stood idle for many years, then was used during World War **II** to house German prisoners of war. In 1952, it was turned over to a church group for use as an old people's home.

Dr. R. E. Coker (personal communication, 1951) stated: *"There were many reasons for the abandonment of Fairport as a biological research station . . in the later 1920's the interest in* **fisheries** *research and the available funds seemed to shift to the west coast and to the northeast . . The station may or may not have been well placed, but it certainly had a distinguished record for its short life."*

VI

COMMERCIAL FISHING

(Written in collaboration with Kenneth D. Carlander[1])

In the early day of settlement along the river there was little organized commercial fishing. Some farmers apparently fished for food for their families or peddled fish around the countryside, but early newspapers of the Mississippi River towns do not mention fish dealers, or market fishermen. Because no licenses were required, the records of commercial fishing at that time are almost nonexistent. By 1876, however, commercial fishing was apparently of some magnitude, because in that year B. F. Shaw, Fish Commissioner of Iowa, advocated a law for the protection of fish during the spawning season in the Mississippi and the Missouri Rivers. He told of several instances where from thirty thousand to eighty thousand pounds of fish were taken in one haul and sent to market *"covered and reeking with their own spawn"* (Fish Commission of Iowa, 1877).

In the Sixth Biennial Report of the Iowa Fish Commission (1886), the Commissioner, A. W. Aldrich, wrote (p. 10):

> *"Up to within a few years, the annual catch of fish from the Iowa side of the Mississippi, and from the waters of the lakes and rivers in the interior of the State, is estimated to have been not less than 4,000,000 pounds! Of this vast quantity of fish at least 2,000,000 pounds was taken at the mouths of Iowa rivers emptying into the Mississippi and Missouri."*

Townsend (1902, p. 715) reported that the years between 1895 and 1899 had been fully as prosperous for the fisheries as at any previous period. *"The total yield has never been greater, and more fishermen are now given employment than ever before."*

The U. S. Commission of Fish and Fisheries and its successor, the Bureau of Fisheries collected statistics on the commercial fisheries of the Mississippi River in 1894, 1899, 1902, 1922, and 1931 (Smith, 1898, Townsend, 1902, Sette 1925, Fiedler 1933). The 1902 survey has not been published in detail, but was summarized in the Bureau of Fisheries Statistical Bulletin No. 175. The Bureau of Census (1911) made a survey of the Mississippi River fisheries in 1908, but Sette (1925, p.

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[1] Iowa Cooperative Fisheries Research Unit, sponsored by the Industrial Science Research Institute of Iowa State College and the Iowa State Conservation Commission.

209) does not consider the figures comparable to the other surveys. Additional statistics have been collected at Lakes Pepin and Keokuk in 1914, 1917, 1922, 1927, and 1931 to 1938 (Coker 1929, Fiedler 1933, 1935, 1936, 1938[illegible], 1938[illegible], 1940, 1941, Fiedler, Manning and Johnson 1934). Each section of the river was covered by a fisheries statistician who asked the fishermen how much gear of each kind they used and how many pounds of fish they caught during the preceding year. Since few of the fishermen and fish dealers kept detailed records, the statistics probably are inaccurate. Despite the approximations which must be made in such a survey, the statistics give a fairly accurate picture of the major changes in the fishery over the period covered (Fig. 16).

The states represented on the Upper Mississippi River Conservation Committee have collected statistics on the fisheries for 1947 to 1950 (U. M. R. C. C. 1948[illegible], 1948[illegible], 1950, 1951, 1952). These statistics are based mostly upon annual recorded sales of fish and are therefore probably more accurate than the earlier surveys. However, not all fishermen reported their catches.

In general, the magnitude of the fisheries has not changed very much over the last sixty years (Tables 2 and 3). The center of the fishing has shifted somewhat to the north. In 1894, Illinois had the largest number of Mississippi River fishermen, but in all later years for which data are available Iowa has had the greatest number. In the 1947 to 1950 period, Wisconsin has had more than Illinois. The total annual catch was apparently somewhat more from 1894 to 1922 than it has been since 1930. The difference in the relative abundance

TABLE 2.-*Numbers* [illegible], [illegible] U[illegible] M[illegible] R[illegible], *1894,* 1899, 1922, 1931, [illegible] 1949-1950

	1894	1899	1922	1931	1949-1950 per year
Fishermen'	2,390	2,937	1,773	1,703	4,161-5,807
Boats	1,841	2,829	2,138	1,650	
Sail and row	1,676				
Row		2,617	1,098		
Steam	1	1			
House	164	111	74		
Motor			966	707	
Gear					
Seines, number	295	381	247	318	
yards	49,520	62,826	63,214	71,909	58,666- 67,857
Entrapment nets	10,163	12,083	11,757	9,023	9,007-9,984
Trammel nets, yards	26,633	26,335	20,395	8,045	30,100- 35,900
Gill nets, yards			31,180	20,314	346,350-424,766
S[illegible], number	4,036	2,751	1,109	2,051	
hooks, number	780,500			262,840	635,532–733,864

'In 1899, the number of fishermen was listed as 2,747 shore workers plus 2,937 fishermen. In 1922, the breakdown was 3,818 shore workers plus 1,773 fishermen. Most of the shore workers were in the button factories. In 1931, the records listed 780 regular fishermen plus 923 casual fishermen. The greater numbers given in 1949 to 1950 are probably due to more complete records. Licenses are now required for all fishermen.

TABLE 3.—Annual *commercial catch, in thousands of pounds, of various species of fish from the Upper Mississippi River in certain years*

Species	1894	1899	1922	1931	1947-50
Carp	453	3,096	6,830	3,294	4,604-5,824
Buffalo	5,939	3,359	2,052	1,364	1,378-2,086
Suckers	851	519	109	217	51- 77
Quillbacks			281	137	80- 112
Drum (Sheepshead)	1,403	804	1,317	590	618-1,062
Bowfin	87	8	29	398	15- 30
Gars					21- 98
Eel	63	32	7	2	.7- 2.5
Mooneye	7	7	-------	2	14- 21
Paddlefish	286	275	135	70	26- 46
Lake sturgeon	249	123	7	0	----------
Shovelnose	423	383	119	57	12- 19
Catfish	3,136	1,824	1,593	885	770–1,149
Pike	112	68	20	5	5- 8
Walleye, sauger, perch	476	110	22	0	----------
White and yellow bass	130	25	6	0	0
Sunfish, crappie, rock bass	204	229	112	0	0
Black bass	70	49	5	0	0
Turtles	4	180	13	38	5- 7
Other	2	14	-------		1- 11
Total	13,728	11,105	12,660	7,061	8,015-9,131

of various species, to be discussed later, is probably more important than any decline in total catch.

The boats used by the fishermen have, of course, changed to some extent during the period from 1900 to the present. In the 1890's, many sailboats were used, and the records list one steamboat—probably a small one, since its value was placed at $650. Over 100 houseboats were listed as being used in the fisheries in the three southernmost states, Missouri, Illinois, and Iowa, in the 1890's. By 1922, the fishermen had mechanized and about half of the boats were motor boats (Fig. 13). Most of the fishermen now use outboard motors or small inboard motors.

Before motors were common, fishermen sometimes made long trips up and down the river by rowing. William Albert (interview at Lansing, Iowa, July 1952) told us of a man who, dissatisfied with the price of fish in New Albin, rowed to Lansing with 3,000 pounds of fish, only to find that he could get no better price there after his eleven mile trip. Even with modern boats, fishermen occasionally must row several miles after their motors fail. One of the old time fishermen at Lansing told about the first motorboat used at Lansing, about 1910. The first time it was used, the owner spent all day trying to start the motor.

The mode of transportation for winter fishing has also changed, with perhaps the most pronounced change taking place since World War II. Oliver J. Valley (1952), the Conservation Officer at Cassville, Wisconsin, reports that in the last three years many commercial fishermen are using ice boats driven by airplane motors and propellors. In the early days, all travel over the ice was by foot or horseback. Later, automobiles and trucks came into general use, but many fishermen preferred to walk, pulling a sled, rather than risk dropping a car or

truck through the treacherous river ice. The new boats or "wind sleds" will skim across ice or water and are safer and faster than cars or trucks.

A unique commercial fishing enterprise on the river was started in 1942 at the Iowa State Penitentiary at Fort Madison. Warden Percy Lainson conceived the idea. of adding to the prison food supply by having prisoners fish in the river, which flows past the prison grounds. The men fished under regular commercial licenses with nets and trotlines and also did some angling for sport. The largest catfish they caught weighed forty-one pounds. They once made a haul of sixteen hundred pounds of carp, the largest weighing thirty-five pounds. Four hundred pounds of fish were required for a meal at the prison (Eddy and Runyon, 1950). During the years the prison fishing project was active, the inmates caught between eighteen and twenty-two tons of dressed fish a year. The food thus provided made a big saving on the dietary costs at the Penitentiary.

The fishing operations at the prison have been discontinued, but could be started again with the expenditure of a few dollars, because they have kept all of their equipment. The fish houses and surrounding area have been converted into a picnic area for the prison employees. The prison fishermen aided both local and Federal officials in making surveys of fishing on the river (Personal communication from Warden Percy Lainson, 1954).

Most of the gear used by the fishermen to catch fish can be classed in four categories: encircling, entrapping, entangling, and angling. A small percentage of the fish have been caught by spearing. Haul seines are used to encircle the fish, usually bringing them to the shore or to a backstop net some distance off shore (Fig. 14). Seines have taken about 40 per cent of the total catch in each of the years for which statistics are available. They are more significant in Minnesota and Wisconsin than they are in the states farther south. In 1949, seines took 63.7 per cent of the Wisconsin catch, 46.8 per cent of the Minnesota catch, 20.2 per cent of the Illinois catch, and 8.8 per cent of the catch in Missouri (U. M. R. C. C., 1951, p. 38). The 1894 and 1899 statistics show a somewhat similar geographical distribution. Since seines require relatively clear areas for landing, seining sites are rather limited in some sections of the river. The impounding of the river eliminated many landing sites and created others, but apparently has not greatly changed the relative importance of seining over large stretches of the river. *The Fisherman* (1951, 19 (6), p. 8) tells of a recent record seine haul in Illinois. The Degerbia brothers of Batchtown, Illinois, seined about 12,000 pounds from Swara Pond, fed by the Mississippi River. The haul contained 8,154 pounds of saleable commercial fish: "buffalo," carp, "perch," "fiddlers," and "spoonbill." These fish were sold for $1,398. The rest of the catch consisted of game fish, mostly "crappies."

In the northern region, much seining is done through the ice. Townsend (1902) stated that "buffalo" and freshwater drum were the dominant species taken during winter seining, north of Dubuque. In January, 1898, the best individual seine haul which had been made in Iowa in the previous two years was 28,000 pounds, including 600 pounds of yellow walleye, 9,000 pounds of buffalofishes, and 18,400 pounds of freshwater drum. At this same spot in March, 1884, a haul of 240,000 pounds was made, consisting largely of freshwater drum. In recent years carp have been taken in large quantities during the winter seining operations.

The lengths of the seines have increased during the period of our records. In 1894, the average length was 134 yards; in 1899, 165 yards; in 1922, 265 yards; and in 1931, 290 yards (Table 1). In recent years the seines have been pulled, to a considerable extent, by gasoline motors. In the early days, they were pulled by hand, or, in some cases, by horses. The seines are usually operated by three to six men.

The gear classed as entrapping includes a wide variety of nets having as their characteristic feature a funnel-like opening (Fig. 17). The fish swim through the funnel into a crib from which escape is difficult. A fence-like net called a lead is used on some traps to direct the fish into the crib. A "wing net" has two leads funneling the fish into the crib. One type of net is called a buffalo net because it is especially effective in catching buffalofishes. Fyke nets, hoop nets, and pound nets are the principal entrapment gear made of webbing, or net. When the traps are made of wood slats or wire they are more properly referred to as "baskets." Townsend (1902) reports that some fishermen around Fort Madison, Iowa, were making their fyke nets out of soft copper wire netting instead of twine. These wire nets were reported to be far more durable and to catch more fish.

The quantity of entrapping gear in use has evidently been fairly uniform in the last sixty years (Table 2). Some of the gear has been modified and improved over the years, but the basic principles and construction are much the same as they were in the first days of the Mississippi River fishery. In the 1890's, from 27 to 31 per cent of the total catch came from entrapment gear. In 1949, such nets took only about 24 per cent of the catch. The entrapment devices are much more important in the three southernmost states than they are in the northern section. Most of the entrapment gear can be handled by one or two men and a single fisherman may fish twenty or thirty nets (Fig. 18).

The fyke nets and other traps usually depend upon the natural movements of the fish and often are set in the natural pathways of the fish. During the 1890's some of these nets were set across the mouths of tributary streams in such a fashion as to capture all fish that tried to go upstream. These "shutoff" nets were outlawed and are no longer used. Various baits are used to attract fish, particularly cat-

fishes and bullheads, to some fyke nets. Stale cheese is the principal bait. Townsend (1902, p. 715) tells of its use in 1899. An employee of the old Boat Store at Lansing, Iowa, said that they used to sell thousands of pounds of cheese every year for use as bait in the nets. The store started in 1910, or a little earlier, and is no longer in existence. (Interview with Mr. Magnuson, Lansing, Iowa, July, 1952.)

Gill nets and trammel nets entangle the fish that swim into them. These nets can be used in deeper water than most of the other gear and have had greater use since the river has been impounded. From 1894 to 1922, the yardage of trammel nets varied from twenty to twenty-seven thousand yards, whereas in 1949 and 1950, from thirty to thirty-six thousand yards were in use. The gill nets show the effects of the change in the river character even more than the trammel nets. No gill nets were mentioned in the 1894 and 1899 reports. The amount of gill net in use in 1949 and 1950 was over ten times that reported for 1922 and 1931. In 1949, about 22 per cent of the commercial catch was taken in gill and trammel nets; in the 1890's, about 11 per cent was taken in the trammel nets.

Commercial fishermen also use angling methods, but are not limited to one or two hooks as in most sport fishing. Long lines, with baited hooks attached at intervals along the line, are used primarily for catfish, but they also catch a number of other fish. The set lines, drift lines, handlines, or trotlines as they are called, are usually baited in late afternoon with suckers, minnows, bowfin, crawfish, dough-balls, cheese, or mussel meats. The baits listed by Townsend (1902, p. 716) are the same as those used at the present time. The set lines can be used in shallow water among stumps and snags where most other gear cannot be fished. The number of hooks in use on set lines in 1950 was almost the same as in 1894, but the numbers of set lines reported for 1899, 1922, and 1931 were considerably lower. Set lines caught about 20 per cent of the commercial catch in 1894; about 12 per cent in 1899; about 5 per cent in 1922; and about 7 per cent in 1949.

As has already been mentioned, the most pronounced change in the fisheries, as demonstrated by the catch statistics, is the change in the abundance of various species of fish. Over half of the commercial catch is now composed of carp, a species not even present in the river before 1880 (Fig. 19). The first records of carp caught in the Mississippi River were at Hannibal, Missouri, and Quincy, Illinois in 1883 (Cole 1905, p. 549). Garman (1890, p. 143) found the carp well established in the bottom land lakes near Quincy in 1888. The first carp taken at Lansing, Iowa, in the 1880's was taken by Sever Olson (William Albert, Lansing, interview, July 1952). This carp was about twelve or fourteen inches long and none of the fishermen knew what it was. When Sever took the fish to town, the German druggist, "Doc" Nachtwey, recognized it. Nachtwey was pleased to see the carp which he had known in Europe, and paid Sever a dollar for it. He subse-

quently paid a dollar for each of the two or three carp caught later - the same year in the Lansing area.

Almost half a million pounds of carp were reported in 1894, and by 1899 the catch had increased six-fold (Table 3). In 1894, carp were reported from Illinois, Missouri, Iowa, and Wisconsin, but not from Minnesota. The early popularity of the carp was short-lived among sportsmen and conservationists, but the carp soon became one of the mainstays of Mississippi River commercial fisheries. The Iowa fish and game warden reporting on the 1909-10 biennium (1911) stated that the "much despised carp" was one of the most profitable industries on the Mississippi. The eastern states furnished, then as they do now, the largest market for the carp.

As the catch of carp increased, the catch of buffalofishes declined (Table 3.) In 1894, the buffalo were the most important species, comprising about 43 per cent of the total poundage. The ratio of buffalo to carp was about 12 to 1; by 1899 the carp and buffalo catches were about equal; in 1922, carp outweighed buffalo by more than 3 to 1; and the 3 to 1 ratio has been maintained rather uniformly since that time. The buffalo catch has declined from about six million to about two million pounds. The decrease in the abundance of buffalo was probably the result of competition from the introduced carp and of changes in the environment. Bartlett (1917) thought that over-fishing was the major cause of the decline, particularly drawing attention to the fishing during the spawning season, when farmers and fishermen took the buffalo by the thousands as they rolled in the shallow water. Coker (1930, p. 194) believed that the reclaiming for agricultural purposes of large shallow water areas which had been used for spawning and nursery purposes was an important factor in the decline of buffalo in Keokuk Lake. The replacement of buffalo by carp even if equal in poundage is not equal in value. In 1947 to 1950, carp brought 4 to 5.5 cents per pound compared to 13 to 15 cents for buffalo.

The catch of suckers and carpsuckers has also declined along with that of the buffalo, being in 1947-1950 only about one sixth as much as that reported in 1894. Sette (1925, p. 210) stated that the appearance of the carpsuckers in the statistics of 1922 for the first time does not necessarily indicate the beginning of a new fishery for that species, but that they previously had been included in the statistics for suckers. At periods of poor markets, many of the suckers and carpsuckers are thrown away and the statistics may not indicate abundance very accurately. In recent years, however, since the markets have generally been good, it is possible that the proportions thrown away and not recorded are less than in the earlier period. Coker (1930, p. 185) reported that usually only carpsuckers over four pounds were kept for the market. Carpsuckers taken during surveys in 1944 and 1946 averaged only 1.24 pounds (Barnickol and Starrett, 1951, p. 292).

Ten per cent of the present commercial catch is made up of freshwater drum, with catfishes, including bullheads, constituting another ten per cent of the total commercial catch. There does not seem to be any clearly defined trend in the catch of freshwater drum, but the catfish catch has apparently declined somewhat from the 1890's to the present. The catfishes are the most sought after of the Mississippi River fishes. In the 1947 to 1950 period, catfish were bringing 22 to 25 cents and bullheads about 20 cents per pound-about four to five times as much as carp. About 25 per cent of the total value of the commercial catch came from catfish and bullheads in these years-although they comprised only about ten per cent of the weight.

Some fishermen believe that there is a cycle in the abundance of bullheads in the river and the catches of these fishes have fluctuated quite markedly over the years. Rose and Jake Ehrlich of the Lansing (Iowa) Fish Market provided us with some interesting statistics on the poundage of bullheads and other species handled at their fishery from 1936 through 1950 (Table 4 and Fig. 20). There appeared to be a period of abundance of bullheads from 1939 to 1943, followed by years of scarcity. Everett Speaker, of the Iowa State Conservation Commission, reported (Barnickol and Starrett, 1951, p. 310) that the bullheads appeared to be on the increase again in 1949. The Ehrlichs (interview, Lansing, July 1952), said that the bullheads, as they become more abundant, seem to move upstream, being first reported, in the stretch of the river which the Ehrlichs know best, from Guttenberg, then Clayton, McGregor, and about a year later at Lansing.

TABLE 4.-*The poundage of fish, in thousands of pounds, of certain species handled by the Ehrlich Fishery, Lansing, Iowa, 1936 to 1950*

Year	Bullhead	Channel cat	Northern Pike	Bowfin	Carp	Buffalo
1936	24.8	61.4	5.7	49.0	408.7	76.2
1937	31.1	85.8	10.7	53.1	462.8	104.9
1938	61.9	93.9	18.4	105.6	254.8	196.2
1939	83.2	43.8	42.6	76.0	371.0	220.5
1940	161.9	80.6	25.0	48.6	220.5	247.6
1941	166.3	115.1	5.2	42.0	247.6	539.4
1942	209.2	95.9	3.8	25.6	406.1	469.7
1943	125.7	125.6	3.6	34.1	746.8	363.0
1944	56.7	136.3	3.7	15.1	828.1	501.4
1945	29.5	159.3	1.3	14.7	1,193.6	417.0
1946	16.9	214.6	2.6	13.5	1,341.0	285.5
1947	21.0	228.5	2.3	2.7	1,618.0	330.8
1948	37.2	219.5	9.1	11.1	1,111.6	408.7
1949	30.9	251.5	11.4	2.4	1,225.0	390.0
1950	66.1	172.6	13.1	1.0	1,050.0	481.7

Several species of fishes have completely or almost completely disappeared from the commercial catch since the 1890's. The yellow walleye, sauger, yellow perch, white and yellow bass, and centrarchids were removed from the commercial lists by legislation, for the most part in the 1920's. In 1894, almost a million pounds of these fishes were included in the commercial catch.

Sturgeons have greatly declined in the commercial catch, from about half a million pounds annually in the 1890's to twelve to nineteen thousand pounds in 1947-1950 (Table 3). The lake sturgeon has practically disappeared, and only occasional specimens are taken by commercial fishermen (Fig. 15). The catch of this species declined by over 50 per cent from 1894 to 1899 while that of the shovelnose showed only a slight decrease. In the early days, lake sturgeon were taken primarily for their eggs—for caviar. The smaller shovelnose sturgeon or "sand sturgeon", were considered a nuisance when the lake sturgeon were still abundant. Ed Saylor of Guttenburg told how as a boy, about 1895, he had helped his father dump the shovelnose sturgeon head down on the sandbars. The boys tied willow switches to the tails of the sturgeon and the fish would work themselves out of the sand and go down the river with the willows waving. Mr. Saylor added that his father disapproved of the procedure; *"we got more of the 'willers' than the fish did"* (interview, May 1950).

Paddlefish showed a somewhat similar, but less precipitate decline in the catch. The 1947-1950 annual catch was only about one tenth that of 1894 and 1899. The possibility that the dams might prevent the migration of the paddlefish was mentioned in an earlier chapter. The decline in abundance has been greater in the northern than in the southern part of the river.

The annual catch of American eels dropped from 63,000 pounds in 1894 to about 1,000 pounds in the 1940's. The eel was once fairly common up the Mississippi River as far as St. Anthony Falls in Minneapolis, Minnesota. Eddy and Surber (1947, p. 192) stated that the dams were undoubtedly responsible for the scarcity of eels in the upper Mississippi. It is rather interesting that the decline in the catch of eels in Minnesota and Wisconsin since the 1890's is no greater than the decline in the entire upper river. In the 1890's, about 29 per cent of the American eels were caught in Minnesota and Wisconsin; in 1947 to 1950, about 32 per cent.

Greenbank (1949) computed that the commercial catch in 1917 meant the removal of sixteen pounds of fish per acre of water surface. The removal was not evenly distributed over the entire river, however. In Pool No. 3, between Red Wing and Hastings, Minnesota, the catch was only 0.6 pounds per acre. This stretch of the river is known to have poor fishing, probably due to pollution from Minneapolis and St. Paul. The greatest production came from Lake Pepin where 87.8 pounds per acre were removed. In general, there was a down-river decrease in production south of Lake Pepin. The Minnesota—Wisconsin section yielded thirty-four pounds per acre compared to 6.7 pounds per acre in the Illinois—Missouri section. After a comparison with the reported commercial catch per acre of other waters, some up to 200 pounds per acre, Greenbank (pp. 5–6) states:

"As shown by the figures, the commercial production in the Upper Mississippi River, 16 pounds per acre annually, is intermediate in the list of widely scattered waters. It is by no means as high as that of some waters mentioned; however, in view of the fact that it apparently is well sustained year after year, it does represent a rather bountiful harvest. Is it, then, an overcropping, or is the resource still being wastefully undercropped? This question perhaps can be answered in full only after the passage of a long number of years and the collection and comparison of yearly catch records. However, there are facts already known which give some clue to the situation. During the few years for which records are available, the production is holding up. Extensive test netting studies have revealed no dearth of standing stock; in particular, the presence of a good proportion of large fish in the stock indicates that there has not been serious overcropping (one possible exception is the sheepshead, the stock of which seems to be somewhat over-balanced with small fish). Nor (again with the possible exception of the sheepshead) has the catch shown any pronounced tendency toward a larger proportion of small fish, as one year succeeds another. Finally, the topographical layout of the Mississippi River, with its shallow and stump-filled areas, serves as a check on over-exploitation by limiting the grounds where fishing is possible.

In the light of these observations, the tentative conclusion to be reached at the present writing is that the commercial species in the Upper Mississippi River are not being over-fished seriously, and indeed may on the whole be under utilized."

In general, the individual fishing units on the Mississippi River are small. Most fishermen fish alone or with one helper. A large seining crew may include six to eight men. Because of the relatively small capital required, many men may undertake fishing during slack times in other occupations. Some years farmers along the Mississippi derive more income from fishing than from their farms (Townsend, 1902). In 1931, about three-fourths of those listed as fishermen were classed as casual" rather than "regular" fishermen (Fiedler, 1933).

Many fishermen are itinerant, moving from one place to another as the fishing success varies. A great many river fishermen have moved from the Ohio or Illinois to try their luck in the Mississippi and some have moved on to other waters. One fisherman interviewed in the summer of 1950 had fished in the Ohio, Illinois, Salt, St. Francis, "Hatchee" (Wassahatchee?), Forked Deer, Mississippi and Amazon Rivers. He had also been a welder, engraver, and a "tank strapper" for an oil company. He likes fishing because he is his own boss and he likes the sport of it" when he gets a big "catfish" on his line (Bob Moxham, interview, Charleston, Missouri, Sept., 1950).

Many other fishermen have spent all their lives in one vicinity, often the same areas that their fathers had fished. Ed Saylor and his wife have spent their lives on the river near Guttenburg, Iowa. The Saylors used to fish forty or fifty fyke nets, but now that they are older they fish only about twenty. Mrs. Saylor has always been her husband's partner in the fishing operations and says that fishing is all she has ever known. Her father was a commercial fisherman immediately after the Civil War. He first fished at Muscatine and then worked his way northward. Ed Saylor's father was a fish peddler.

The Gibbs family at Lansing and the Mays family at New Albin, Iowa, are other examples of families which have fished in the same locality for several generations. George "Stub" Mays' grandfather caught the first carp at New Albin in 1887 (interview, New Albin, Iowa, August, 1952).

Most of the fishermen own their gear, but occasionally a fish dealer may provide the gear on shares. In the old days most of the fishermen made their own webbing for seines and impounding nets. Now most of the fishermen prefer to buy ready-made webbing. A few old timers still **"knit"** their nets, particularly during the long winter evenings or at other slack periods. They claim that the home made nets hang better than the commercially manufactured nets. Ed Saylor is one of those who still "knits" his hoopnets. He said that his father-in-law, who taught him the art, could make anything that could be made from twine. It now takes Mr. Saylor a little over a day to make an average size hoop net which would cost him about $37.50 commercially. When he was younger he could make a complete net and get another set up for the next day. Once he knew a woman who could make two a day, "standing up all the time."

Some of the fishermen use several types of gear at different seasons. Others stick to a certain type and loyally claim that the other types are destructive or do not produce as high a quality of fish.

Many of the fishermen live in houseboats or shacks along the river **banks,** frequently in small communities or fishing villages such as Batchtown, Illinois. Others are among the most substantial citizens of **the** many picturesque villages and cities along the river. In many of the towns, fishing is the principal source of income.

Some fishermen pack, ice, and ship their own fish to the markets—usually Chicago or New York. Most of the fishermen, however, take their fish to a local dealer who handles the problems of packing and distribution. Some of the fish are sold directly to the public at the dock or fish house, but the volume of this business is rather low in most areas. Most of the itinerant fish peddlers who used to sell fish in small towns throughout the area have been replaced by modern meat markets. We did interview one fisherman who had made an old school bus into a traveling fish market which his wife and her mother operated and he **kept** them supplied with fish (Bob **Moxham,** Charleston, Missouri).

The modern methods of handling fish and refrigeration have probably resulted in less waste and fewer losses. Bartlett (1917) stated that in the early days the fish had to be marketed immediately. They were shipped by boat, generally to St. Louis, from points all along the Illinois and Mississippi Rivers. The buffalo were shipped in barrels, sugar hogsheads, crockery crates, boxes—anything available at the time. If time permitted, the fish were dressed, if not, they were shipped "rough." At times so many were offered that a large proportion of them were refused by the boats. The boat trip took from ten to twelve hours and the fish packed and shipped the day caught, if possible. Most of the fish were shipped on consignment and an investigation showed that more than half of the shipments were dumped into the river because of the glutted market and the soft condition of the fish. Accounts often showed a balance due the consignee when the sales failed to pay for the freight. The output of the principal commercial species (buffalo) decreased so rapidly in Illinois that in 1917 the number of fish dealers had dwindled to a few here and there in the towns along the river. They shipped dressed fish to inland towns and sold some fish locally.

The first refrigerated car of fish from the Middle West went to New York in 1896 and those fish brought the top price at that time (F. A. Brown, Muscatine, interview, July 1950).

Some of the markets maintain ponds where the fish can be kept alive for future shipment. The Toledo Fish Company, Stockholm, Wisconsin, dug a large pool in 1920 to hold carp for fattening and for shipment when market prices were better. The Ehrlich fishery at Lansing, Iowa, which for many years has handled more fish than any other fishery on the Upper Mississippi, has many holding ponds for carp. The fishery was first established about 1900 in La Crosse, Wisconsin, but moved to Lansing in 1914. Wisconsin was restricting the sale of fish to a greater extent than was Iowa. The Ehrlich Market is now (1953) run by Rose and Jake Ehrlich, daughter and son of the founder.

The Fred Brown Market in Muscatine also has a long history, having been established in the 1870's. In this case, however, the Market has changed hands a number of times and for many years was known as the Bristol Fishery. These two markets are mentioned only as examples of the many along the river which have long records of service.

Changes in tastes and the popularity of various fishery products have had an effect on the fishing industry of the Mississippi River. During the nineteenth century, the lake sturgeon was not considered particularly good to eat and many carcasses were discarded after the eggs were taken for caviar. Now sturgeon meat often brings the highest price per pound of any river fish. The Jewish people have always been the principal purchasers of the carp shipped to the eastern markets. "Gefilde" fish, prepared from carp, is a particular delicacy but its preparation takes quite a bit of time which modern housewives do not care to spend. Jake Ehrlich believes that the younger Jewish

generation raised in this country does not care for carp and that there has, consequently, been a marked decline in the demand for carp interview, Lansing, Iowa, August, 1952 .

Taylor 1951, pp. 402-404 in his discussion of the economics of the United States fisheries cites the history of the Mississippi River and Great Lakes fisheries as different from that of any other region. From 1890 to 1940:

> "the population of the mid-west grew to great proportions, and villages grew to cities at a time when ocean fisheries had little access to the market. A taste was established for small-sized fresh water 'pan' fish of the lakes and rivers; the growing population and developing delicatessen popularity of whitefish, lake trout, perches, catfish, etc., put heavy pressure on the definitely limited supply of the Great Lakes and Mississippi River system. . . . In response to insistent demand, prices rose disproportionately to the diminishing supply so that the Great Lakes experienced the greatest rise in prices of all the regions of the country, and is the only region of the country to have a higher average price for its fish in terms of purchasing power in the 1921-1940 period than in the pre-1908 period. The percentage improvement in income in dollars of constant purchasing power per fisherman exceeds that of any other region."

Although sufficient statistics are not available for the Mississippi River, its fisheries probably fared economically with the Great Lakes fisheries since their markets were much the same.

> "As supplies in the Lakes and rivers became scarcer, rising prices checked sales and performed their classic function of rationing the product to those who were able and willing to pay. . . . The rising prices and scarcity of Lakes and river fishes became a powerful attraction to fisheries elsewhere, at first drawing imports from the Canadian lakes; they generated the whiting fishery at Cape Cod about the time of World War I and, this not being enough, they furnished part of the incentive of the sales of other ocean fish fillets and various fishes from both Atlantic and Pacific, and even the catfish production as far away as Lake Okechobee, Florida. Undoubtedly, the shipment of whiting and redfish both being in size and structure suggestive of small freshwater fishes to the mid-west contributed to checking somewhat the rise of prices of Lakes and river fish."

With the rapid expansion of quick freezing, of packaging of frozen fish, and of storage facilities in retail stores and homes, particularly evident since World War II, the marine fisheries compete more directly with the river fisheries and a price differential in favor of the locally produced fish will probably no longer be maintained. The fact

that Mississippi River fisheries are scattered over a stretch of hundreds of miles and generally do not bring large poundages to a given point at any one time probably will hinder the development of large processing and freezing plants. Carp do not freeze well and discolor with usual freezing methods. However, there are certain species, notably the carpsuckers, only partially utilized, which might serve as the basis for processing plants if new products are developed from them.

Compared to the total poundage of fishery products produced in the United States, the Mississippi River fisheries seem rather small. In 1949, when the total Upper Mississippi River catch was recorded at nearly nine million pounds, the United States catch was estimated at almost 4.8 billion pounds (Anderson and Peterson, 1952, p. 3). For certain species, however, the Mississippi is the major producer. The 1949 catch of buffalo was over twice that reported from all other waters; the 4.7 million pounds of carp were over half of the poundage produced from all regions. Practically all of the carpsuckers reported in the commercial catch came from the Mississippi. The Mississippi River supplied over 6 per cent of the nation's supply of catfish and bullheads. Although only about 0.2 per cent of the total poundage of fish taken in the United States fisheries comes from the Upper Mississippi, the 5,807 fishermen reported for the latter area in 1949 comprise about 3.6 per cent of the total number of fishermen listed for the country. The fact that the capital needed for Mississippi River fishing is relatively small and that many of the fishermen work only part time probably accounts for the disproportionately large number of fishermen. The Mississippi River fish brought, in 1949, an average of 8.8 cents per pound compared to the national average of 7.06 cents per pound. Some of the large fisheries nationally, such as the pilchard or sardine fishery, depend upon a product that brings the fisherman little more than one cent per pound.

The Mississippi River fisheries play a significant part in the economy of several of the communities along the river. In addition to the five to six thousand fishermen who receive all or much of their income directly from the fisheries, there are several hundred who derive income from the shipping and marketing of the fishery products. The net manufacturers, box makers, boat builders, and manufacturers of outboard motors, boots, slickers, and numerous other objects profit directly from the fishing industry. The value of the fish was reported as $678,812 in 1947; $701,631 in 1948; $782,545 in 1949; and $971,764 in 1950 (U. M. R. C. C. Proceedings, 1949, 1950, 1951, 1952). These values are the prices received by fishermen, the retail values were somewhat higher.

Two tenths of one per cent of the total of the United States fisheries! That seems such a small industry. But an industry whose product brings in almost a million dollars a year is in itself worthy of notice.

VII

SPORT FISHING

In addition to the commercial fishery, the Upper Mississippi River supports a sport fishery of considerable magnitude. It is probable that the recreational values of the river fishes are greater than their commercial value. Records of the sport fishery are difficult to find and are generally so incomplete that it is almost impossible to make an evaluation of the fishery at various stages in its development. Only since 1944 has any systematic measure of its magnitude been attempted.

The history of the sport fishery up to 1944 must come from the reports of a few fishermen who made permanent records of their catches and from scattered items in newspapers and magazines. The records of three fishermen who fished different points on the Mississippi River in 1846, in the 1860's, and in 1878 make particularly fascinating reading.

In 1846, Charles Lanman traveled in the region of the Upper Mississippi, mainly by steamboat. Lanman had many different positions during his lifetime. He was once private secretary to Daniel Webster who wrote on the fly-leaf of a book which he presented to Lanman, *"To my much respected friend and junior brother angler, Charles Lanman"* (Goodspeed, 1939, p. 169). **Lanman** wrote that almost every steamboat on the river was provided with cotton lines and common hooks for the use of passengers, steamboat hands, and raftsmen who angled for the catfishes, most famous of the river fish.

Near Alton, Illinois, Lanman and a companion took *"assorted tackle with about two* ***pounds*** *of beef"* and went off in a skiff for an hour's sport. They moored their boat in the mouth of a bayou and almost immediately the line was made taut by a "catfish." However, the line snagged and "a savage little steamer from Keokuk" swamped their boat so that **Lanman** and his friend had to swim to shore as the fish went *"scooting away toward the torrid* zone" (Lanman, 1856, I, p. 85).

Lanman listed two varieties of "sturgeon," the "common" and the "long-bill," as being the largest of the fish in the river. This is rather curious, because the catfishes are almost universally considered the largest by other observers. He says that like all of the larger fish of the Mississippi their flavor is far from being delicate. He called the "sturgeon" a plebian fish and classed it with the "mullet, sucker, rock bass, sunfish, billfish, bullhead, and chub." He said that he could affirm from personal knowledge that all these fish were abundant in

the Mississippi. The "mullet" probably refers to one of the redhorse. The "pickerel" and "perch" abounded, but were inferior to those of New England, in his opinion. By "pickerel" he may have meant either the northern pike or the yellow walleye. "Whitefish" were found in many of the lakes which emptied into the river, but anglers never caught them.

"Muskalounge" and northern pike, Lanman observed, were very similar, and he had originally considered a muskie just an overgrown pike. Later, he decided, correctly, that they were distinct species. He thought the pike was bolder and a better fish for the angler, but conceded that the "muskalounge," because of his great size and "hyena-like character," was a fine fish for spearing by torch light. Lanman caught his "handsomest pike" in Lake Pepin on a mammoth fly with which he had been fishing for "trout." The pike weighed more than twenty-one pounds, was very fat, and had a black back and silvery belly.

Lanman's tastes and preferences in fish were apparently based upon the fishes with which he was familiar in New England. He does not seem to have had any enthusiasm for the catfishes. He wrote of them (Lanman, 1856, II, P. 389) :

> *'. . . this fish is distinguished for its many deformities and is a great favorite with all persons who have a fancy for muddy water. In the Mississippi they are frequently taken weighing upwards of one hundred pounds . . . but it has always seemed to us that it requires a very powerful stomach to eat a piece from one of* **the** *mammoths of the western waters."*

Present day river people and visitors consider the catfishes very choice.

The best and one of the most widespread fish on the Mississippi in 1846, according to Lanman, was the "black bass." Specimens varying in weight from one to seven pounds were taken on a fly, minnow, or frog. As a game fish it was considered second only to the "trout." Lanman's "black bass" was probably the smallmouth bass although the largemouth bass also occurs in the river. It was found in great abundance in all of the rapids of the river, but furnished particularly good sport at the Falls of St. Anthony. At that place, Lanman caught thirty-five "superb bass" in two hours, without once moving the anchor of his boat. He took them on a hand line baited with a minnow. The majority of the bass weighed over two pounds apiece. The "trout" referred to was, at that date, undoubtedly the eastern brook trout. The only respectable trout region extended from Prairie du Chien to Lake St. Croix. Even in 1846 this section of the river yielded only an occasional trout, and these probably came from nearby brooks.

Lanman referred to the region from Prairie du Chien to Lake Pepin as the "Alpine Region". He said that the very best fish in the Missis-

sippi were found in Lake Pepin, which he called the "Horicon of the wilderness" (II, 389).

> *It is surrounded with hills which abound in almost every variety of game; its shores are gravelly, abounding in valuable agates and cornelians, the water is clear and very deep, and it yields the very best fish in great abundance. (I,* p. 30).

Twenty years after Charles Lanman had fished in Lake Pepin and had spoken of it so favorably, another fisherman wrote of it with even greater enthusiasm. Oliver Gibbs, Jr., a horticulturist whose hobby was fishing, lived for a few years at Lake City, Minnesota, and then moved to Prescott, Wisconsin (Upham & Dunlop, 1912). The letters which Gibbs wrote about fishing in Lake Pepin in the 1860's were written "for the amusement of' General F. E. Spinner, the Treasurer of the United States, and a small group of friends in Washington, D. C. Spinner had them printed in the *Spirit of the Times,* which was the outstanding sporting magazine of the period, and then the letters were collected in a little paper bound book, *Lake Pepin Fish Chowder* (1869).

Gibbs said that he preferred fishing in Lake Pepin to fishing in the interior lakes, because it was possible to catch a greater variety of fish, though perhaps not such a great number of any one kind (pp. 121-122):

> *"It greatly enhances the excitement and pleasure of fishing to be able in one day to catch three or four kinds of bass, two of pickerel, two of pike-perch, the mascalonge and a dozen kinds of other curious and gamey, handsome fish—to say nothing of now and then a lunkhead which is the name Dr. Estes and I have agreed upon for the fish that are not gamey, till future generations shall find a better one . . ."*

Sometimes Gibbs caught as many as twenty species in one day's fishing. The "pickerel" was "heavy sport" in summer fishing, gathered in cool water at the mouths of spring brooks. At a very primitive and beautiful spot on the lake he caught a twenty-five pound "pickerel" and several smaller ones. The "pickerel" was probably the northern pike. At another time he caught a ten pound "pickerel," commenting that there were some "monster pickerel" there which weighed twenty and even forty pounds. The "maskinonge" was fished for along shore only after a few frosty nights in the fall. Then by trolling, either from a boat or from shore, using either bait or spoon, many of the large fish could be caught. Their flavor was fine, equal, in Gibbs' opinion, to any freshwater fish except the eastern brook trout.

In *Lake Pepin Fish Chowder,* there is a picturesque description of that wonder of all the Mississippi River fish, the paddlefish, or "bill-fish." It had a chunky dark blue body and white belly, with a two-foot

bill like a boat's paddle. Gibbs had been watching the fish from the deck of a boat (pp. 22-23) :

> *"He comes* up, *seems to stand an instant on his tail, and then clumsily falls into the water with a splash as if someone had thrown a slab overboard. He got up to see what boat was coming; many others, pricked by the same curiosity will do likewise. . . . In hot days they will swim lazily by a boat, dropping their under jaws and holding their cavernous mouths open, as if they expected the cook to throw in a pail of garbage."*

The paddlefish is now known to feed primarily upon plankton, microscopic plants and animals which it strains from the water by swimming with its mouth open. Before passing out over the gills the water filters through the "gill rakers" which look like the teeth of a very fine comb.

One of the favorite fishing spots on Lake Pepin was the long sandy point which stretched into the lake directly in front of Lake City. Although it was the landing place for all the steamboats, there was almost always good fishing there, especially for the yellow walleye, white bass, yellow bass, "pickerel," and hickory shad. *"And if you leave your minnow near the bottom, some big catfish is likely to take it and give you a half an hour's resolute business killing him."* Like many other game fishermen, Gibbs was not overly fond of the catfishes.

Gibbs' prize catch from this favorite point consisted of thirty-two game fish in two hours' time. They included two kinds of walleye, the large yellow walleye and the small sauger, or "Ohio salmon," three varieties of bass, the smallmouth bass, the yellow bass, and the "speckled bass." The "speckled bass" is the black crappie. The last fish he caught was a sixteeen pound blue catfish which he did not count.

None of the books which Oliver Gibbs consulted contained descriptions which he thought fitted the "striped bass of the lakes" and the "speckled bass." The striped bass of the lakes closely resembled the true striped bass of tidewater, but was broader and never grew to weigh more than four pounds. It ran in great schools, especially when the brown flies called "mosquito hawks" swarmed on Lake Pepin. It never stayed in one spot very long and a fisherman had to work fast to catch any before the school moved on. They made the water boil with their jumping when they encountered a school of minnows. Gibbs said he had had his best sport with them in the middle of the day, although they appeared in greater numbers "in the edge of evening" when the flies swarmed over the water. Gibbs was correct in thinking that this species was the white bass.

The brilliant colors of the "speckled bass," covered with brilliant spots of brown, green, azure, and golden shades," made Gibbs doubt that it was a crappie. He described it as the gamiest of freshwater fishes. Either the Lake Pepin crappies were unusually bright or the

bill like a boat's paddle. Gibbs had been watching the fish from the deck of a boat (pp. 22-23) :

> *"**He** comes* **up,** *seems to stand an instant on his tail, and then clumsily falls into the water with a splash as if someone had thrown a slab overboard. He got up to see what boat was coming; many others, pricked by the same curiosity will do likewise.* **. . . *In*** *hot days they will swim lazily by a boat, dropping their under jaws and holding their cavernous mouths open, as if they expected the cook to throw in a pail of garbage."*

The paddlefish is now known to feed primarily upon plankton, microscopic plants and animals which it strains from the water by swimming with its mouth open. Before passing out over the gills the water filters through the "gill rakers" which look like the teeth of a very fine comb.

One of the favorite fishing spots on Lake Pepin was the long sandy point which stretched into the lake directly in front of Lake City. Although it was the landing place for all the steamboats, there was almost always good fishing there, especially for the yellow walleye, white bass, yellow bass, "pickerel," and hickory shad. *"And if you leave your minnow near the bottom, some big catfish is likely to take it and give you a half an hour's resolute business killing him."* **Like many other game fishermen, Gibbs was not overly fond of the catfishes.**

Gibbs' prize catch from this favorite point consisted of thirty-two game fish in two hours' time. They included two kinds of walleye, the large yellow walleye and the small sauger, or "Ohio salmon," three varieties of bass, the smallmouth bass, the yellow bass, and the speckled bass." The "speckled bass" is the black crappie. The last fish he caught was a sixteeen pound blue catfish which he did not count.

None of the books which Oliver Gibbs consulted contained descriptions which he thought fitted the "striped bass of the lakes" and the speckled bass." The striped bass of the lakes closely resembled the true striped bass of tidewater, but was broader and never grew to weigh more than four pounds. It ran in great schools, especially when the brown flies called "mosquito hawks" swarmed on Lake Pepin. It never stayed in one spot very long and a fisherman had to work fast to catch any before the school moved on. They made the water boil with their jumping when they encountered a school of minnows. Gibbs said he had had his best sport with them in the middle of the day, although they appeared in greater numbers "in the edge of evening" when the flies swarmed over the water. Gibbs was correct in thinking that this species was the white bass.

The brilliant colors of the "speckled bass," covered with brilliant spots of brown, green, azure, and golden shades," made Gibbs doubt that it was a crappie. He described it as the gamiest of freshwater fishes. Either the Lake Pepin crappies were unusually bright or the

picture Gibbs consulted was a poor one, because the "speckled bass" was undoubtedly the black crappie.

Gibbs reported the "hickory shad" as being found in great numbers in all parts of Lake Pepin. It took a minnow or a fly, was very gamey and had the flavor of the American shad. He said it appeared to be identical with the "freshwater tailor" found in the "Washington City fishmarket" in 1869. The "hickory shad" was a colloquial name for a number of species, but in Lake Pepin it probably meant the skipjack which proved so important in the life history of the "niggerhead" mussel. Gibbs also mentioned a "gamey little herring" that would bite at a minnow and looked like a good fish though he had never tasted it. This was probably the mooneye.

Oliver Gibbs' prize catch on Lake Pepin, in terms of weight, was made in the summer of 1868. It consisted of nine yellow walleye which weighed a total of fifty pounds, one smallmouth bass, one white bass, and one northern pike. The pike, a seven-pounder, broke his rod or he would have caught many more fish. He was using chubs for bait. Gibbs considered the catch most unusual because of the size of the fish. He attributed the size of the catch to the fact that a strong wind blowing for three days and three nights had moved the fish inshore. He had to take his catch home in a wheelbarrow. He had a warning for fishermen who might expect a catch of that magnitude every time they went fishing on Lake Pepin (pp. 122-123):

"I hope that no one will go there with the expectation that he can catch any everlasting great quantity of fish every time he goes a-fishing, or succeed at all without studying the prime conditions of weather, time of day, and localities, or catch many without being a good fisherman. . . . Anybody can have good fun in boating and take some fish, but it takes a workman, ordinarily, to bring home a good string if fairly caught, and I know of no place elsewhere to which the same remark is not applicable."

Lake Pepin was the inspiration for several poems by Oliver Gibbs, Jr. One brief example is his "Epitaph for a Fisherman" (p. 15) :

"Save that his soul
May reach the goal
Where all good people steer,
Tis his last wish
To hunt and fish
In Heaven the same as here."

There is a careful record of fishing in the overflow lakes in the Mississippi River bottoms near St. Louis, in the summer of 1878. The small notebook entitled "Piscatorial Diary", by George Barton Berrell, is in the possession of the Missouri Historical Society of St. Louis (Carlander and Carlander, 1951). Mr. Berrell, stage manager of the

St. Louis theater in the late 1870's, kept a record of eighteen fishing trips which he took in the company of various friends, or, on occasion, by himself. He went by ferry and train to the lakes where he pursued what he described as *"my favorite, I might say my only amusement."*

Anglers who long for the "good old days" would find Mr. Berrell's diary enlightening. It would, perhaps, make them more satisfied with their own fishing success. Berrell was thrilled to catch crappies weighing from eight to ten ounces. Once he caught one which weighed one pound, six ounces, and that one caused quite a furore among all of the fishermen at the lake. The only fish which he recorded as weighing more than two pounds were catfish which he took on a trot line.

He fished in the rain and on days when the temperature was ninety-nine degrees in the shade. When he caught a fish which he did not recognize he described it in his diary and checked it in reference books.

The fishes most commonly recorded in the "Piscatorial Diary" are crappies, largemouth bass (which Berrell called the green or grass bass), the rock bass, and a variety of catfishes including the "common yellow cat" which was probably the black bullhead, *Ameiurus melas.*

On a trip to Choutou's Slough, Illinois, Berrell and three friends had good luck in taking a large variety of species, though on other trips they had caught a greater number of fish. The theater had closed for the summer and Berrell and his companions took the barest necessities for an overnight camping trip. It was June 12, 1878. The water was four or five feet higher than it had been when Berrell had fished at Choutou's the year before. The four men began to fish almost as soon as they arrived at the lake and scarcely stopped even to eat or sleep. Altogether in the two days, they caught five striped bass, four green bass," eight rock bass, one "great yellow cat," eleven "common yellow cats," three "blue cats," nineteen crappies, one "white perch," (the freshwater drum), three "jack salmon," six "hickory shad," one bowfin, and one "gar-pike." In addition to his regular fishing tackle Berrell took a two hundred foot trot line, hoping to catch some large fish to augment the group's food supply. With this he caught a six-pound, ten ounce "great yellow catfish" and several smaller blue catfish and a "common yellow catfish" which weighed only ten ounces.

Berrell identified the "white perch" as the freshwater drum, *Aplodinotus grunniens,* the "jack salmon" as either *Lucioperca canadensis* or *Lucioperca pepinus,* both of which scientific names are now synonyms of the modern name of the sauger, *Stizostedion canadense.* The "hickory shad," he said, looked more like the mooneye, *Hiodon tergisus,* than like the hickory shad of Ohio. Of this trip Berrell wrote, *"I doubt if ever a greater variety of fish, eleven different species, was ever taken from one body of fresh water."* He actually listed twelve species. Berrell used a variety of baits, including worms, minnows, and artificial flies, and a set line baited with liver.

Berrell and his friends reached the lakes and sloughs by train, ferry, wagon, or on foot. At one time a railroad ran a special excursion train to *a* lake in order to advertise the recreational opportunities (p. 422). Several entries in the diary mention large numbers of fishermen who used the lakes.

Berrell and a friend, Billy Hughes, took a trip to Bluff Lake, Illinois, on May 22, 1878. At the lake they found a Granger picnic in progress (pp. 425-426):

> *The railroad embankment and the trestlework were covered with anglers of all ages and sexes, and the shouts of the men and the screams of the girls were enough to scare all the fish off to the deepest recesses of the lake . . . . To get away from the noisy crowd, we hired a skiff and rowed a couple of miles up the lake.*

Information on the spots where Berrell fished was supplied by the District Engineer (St. Louis) of the Corps of Engineers of the United States Army (personal communication from Major E. B. Campbell, Feb. 9, 1951). Most of the lakes have disappeared, through drainage, silting, or improvements for navigation. Choutou's Slough has been largely eliminated by the Chain of Rocks Canal which follows the course of the old slough for some distance. Pole and line fishermen used it to some extent before work began on the locks and canal, but fishing success has been rather poor for some years. Long Lake, which was the most frequented fishing site, was really more of a long slough than a lake. It had its upstream entrance approximately opposite the mouth of the Missouri River and circled inland to the vicinity of Mitchell, Illinois, then riverward again, emptying into Choutou Slough. The area has been materially reduced through silting and drainage. Some fishing is still carried on along the old lake and its related drainage ditches. The upper portion of the lake has been rather intensively developed through construction of many recreational cottage sites. Fishing in this area is reported to be fair.

A summary of the fishing which Berrell and his companions did in these river bottom lakes and sloughs indicates that they took about 10.6 fish per man day of fishing. This figure is somewhat higher than the average day's fishing in warm-water lakes at the present time (Carlander, 1950). However, Berrell and his friends did not have to worry about catch limits as modern day fishermen must. Their average was raised by a few days in which forty to sixty fish were caught. On other days, Berrell had to be satisfied with two or three fish. The estimated average catch per man-hour for Berrell and the others was 1.4 fish. The median catch per man-hour in warm-water lakes at the present time is 1.3 fish. The most comparable creel census data are those for Weber Lake on the Missouri side of the Mississippi River near St. Louis in 1950. Here the average catch per man-hour was only 0.155 fish (Campbell, personal communication). This figure is much

lower than the estimated catch for Berrell in 1878. Greenbank (MS) reports that on the Upper Mississippi near La Crosse in 1945 and 1946 the average catch was about 0.5 fish per man-hour.

The size of the fish taken is more indicative of the fishing luck of 1878 than the number taken. The average weight of all the fish for which Berra recorded weights was three ounces. The catfish caught on the set line are the only fish recorded as weighing more than two pounds. The "lunkers" or "whoppers" which old timers have so often told us they used to catch are not reported at all by George Barton Berrell in 1878.

A diary kept by Julius Barthold of Lansing, Iowa, from 1913 to 1919 showed the catches on a number of trips each fall (diary loaned by Fred Schafer, July, 1952). Many of the trips were combined fishing and hunting trips and it is not known how much time was spent in fishing each day. The following tabulation indicates that the fishing was good when judged by present standards:

Year	No. of trips	Northern Pike	Small-mouth Bass	Total	No. per trip	Average catch per man-day
1913	5	80		80	5-29	
1914	3	40	13	53	9-27	
1915	5	50	3	53	4-18	
1916	4	38	17	55	2-22	
1917	10	203	29	253	0-64	7.2
1918	14	263	14	346	4-64	8.4
1919	6	58	26	100	0-31	5.6

Barthold makes no reference to fish other than pike and bass except for one carp and one channel catfish. On some trips he gave the total number of bass and pike with no break-down and therefore the totals include some fish not indicated in the other two columns. He reports a few of the larger fish, listing the following as the largest northern pike on various trips: four six-pounders, two seven-pounders, 7¼ pounds, 8½ pounds, nine pounds and 9¼ pounds. The sixty-four fish caught on the best trip in 1918 weighed 88 pounds.

George Barton Berrell and Oliver Gibbs, Jr., were both intrigued by the variety of fish which could be caught in the river. Mel Ellis, writing in the *Milwaukee Journal* in the summer of 1949, was impressed by the variety of fishing spots available in the river.

"If you haven't fished Ol' Man Mississip, forget about any preconceived notions you may have as far as rivers are concerned. Because Ol' Man River isn't really a river at all. In fact, he's a hundred rivers and a thousand lakes and more sloughs than you could explore in a lifetime. He is creeks, bayous, ditches, puddles, and thousands and thousands of impenetrable lotus beds that break big yellow flowers out above green pads."

A phenomenon of the late nineteenth and early twentieth centuries along the river near large cities, particularly St. Louis, was the hunting and fishing club. Goodspeed (1939) indicates that such clubs were prevalent in the East in the early 1800's. Members would lease or buy land along the river or overflow lakes and build a clubhouse which they used as headquarters. The oldest organization of its kind in St. Louis was the North St. Louis Hunting and Fishing Club, organized "away back in the sixties." Some of the clubs were called Hunting, Fishing, and Literary Clubs. There is no record of literary activities, but by having that designation in their name, they could be incorporated under the education law (Ellis and L. A. S., 1905).

In 1915, and perhaps in previous or following years, a group of fifteen or twenty business and professional men from Dubuque hired a houseboat and took a trip up the river to Lansing, Iowa, for a period of hunting and fishing. They called themselves the PiCi Club (W. E. Albert, interview, August, 1952). The PiCi Club found particularly good smallmouth bass fishing around the riprap of the closing dams which had been built to make a four-foot channel. The dams had sunk, making good shelter for the bass.

Lansing, Iowa, and the upper Mississippi are described by H. J. Metcalf in a small book titled *The True Garden of Eden.* The book is undated, but according to information from Mr. W. E. Albert, it was written about 1909. Clothing styles in the illustrations tend to confirm that date. The little book is a panegyric to the beauties and sporting opportunities of the Mississippi River, but gives little concrete information. There is a chapter of amusing fish stories, with sly hits at game wardens and other law enforcement agents.

One story told of a fisherman who said he always carried a pistol when he went fishing on the Mississippi. He said the fish were such fighters that if he didn't shoot them they would throw him out of the boat once he had landed them.

While a large proportion of the fishermen on the Mississippi are local residents, many sportsmen come to the river from other parts of the country. For example, in 1911, the mayor of Chicago fished near Wabasha, Minnesota, and reported the best smallmouth bass fishing he had ever had. He regretted that he had lived fifty years before he discovered that fishing spot (Streckfus Steamboat Line, 1913). Two dentists from Missouri found that same fishing spot in 1929. On a rainy day, one of them caught the largest smallmouth bass which had been caught there in eight years. Caught on a "little red spider" or "red bucktail", it weighed just two ounces less than five pounds (Von Schriltz, 1930).

A peculiar sport on the Mississippi, especially in the region bordering Missouri, is "jugging" or "blocking." To fish in this way, a fisherman puts out a set line with jugs or cans tied to it. Then he watches

until one of the jugs or cans is pulled under the water by a catfish, which he then brings to shore (Spears, 1922).

La Crosse, Wisconsin, has always been a center of sport fishing on the Mississippi. In recent years the interest has increased, as western Wisconsin sportsmen have sought to obtain more attention and money from the Conservation Department. They claimed that the Mississippi River was the "forgotten region" and its sportsmen were the "forgotten men" of conservation (La *Crosse Tribune,* Sept. 17, 1944).

The *La Crosse Tribune* carries frequent stories of good catches made in the river. A Des Moines, Iowa, man caught a thirty and one-quarter pound catfish on a **"Go-Deeper"** plug near La Crosse, on his return from a "not too exciting" fishing trip to Canada in 1949 (Oct. 2, 1949).

In the last few years the dams have been favorite fishing places (Fig. 17). Since 1946, a regular count of the anglers who use the dams has been made by the **lockmasters.** They are trying to determine the use of the dams by fishermen and also the effect of the dams on fishing. During October, 1948, the lockmasters counted 6,760 private fishermen. This was an increase of 1,792 over September of the same year (La *Crosse Tribune,* Nov. 28, 1948). Fisherman counts were also made from an airplane by Dr. John Greenbank.

Angling through the ice has become increasingly popular along the River. Near Prairie du Chien, the fishermen found "helpers" in the bald eagles which soared over them as they fished through the ice. The birds, as well as Wisconsin and Iowa fishermen, were reported to be very successful in catching "pike" below dam Number Nine, which is north of Prairie du Chien (*La Crosse Tribune,* Feb. 19, 1947).

The most comprehensive picture of the present day sport fishing on the Upper Mississippi River was secured by a creel census conducted by Dr. John Greenbank (MS) and other personnel of the Fish Technical Committee of the U.M. R. C. C. The creel census was carried out during two summer seasons, 1944 and 1945, and two winter seasons, 1944 45 and 1945-46. During the census, 40,000 fishermen were interviewed. The field men taking the census estimated that they constituted from 30 to 60 per cent of the total number of fishermen. This estimate was corroborated by airplane counts of fishermen. Fishing success was at a low ebb during this time and since then fishing success has greatly increased. There is a trend toward greater and greater fishing pressure on the river. During the five-year period, 1945-49, the 225-mile stretch from Red Wing, Minnesota, to Dubuque, Iowa, averaged 150,000 fishermen during the summer season and about 25,000 in the winter. There were probably about 60,000 summer fishermen in 1945 and 250,000 during the summer of 1948 and an equal number in 1949 (Greenbank, MS, Sixth Progress Report, 1950, pp. 12-13). The increased availability of tires and gasoline after the close of World War II was, of course, a factor in the increased number of fishermen

after 1945. The number of winter fishermen remained much the same throughout the period. Most of the ice fishing is done by people living near the river, whereas many fishermen travel long distances for the summer fishing.

In the low season of 1945 the summer catch totaled about 120,000 fish. In 1948 and 1949, the total was about 1,000,000 fish.

The greater fishing pressure on the Mississippi River in recent years is due to the generally growing interest in fishing which is evident everywhere in the United States and, also, to the reports of ever better fishing success on the river.

The great variety of fish which can be caught in the river is one factor which makes the Mississippi such a popular and attractive fishing water. Twelve species of warm water fish appeared in the creels of the fishermen contacted (Greenbank, MS, p. 11). Bluegill and black and white crappie made up about half of the total summer catch and the great bulk of the winter catch in some areas. Yellow walleyes and saugers are fished for in the fall.

Most of the sport fishing on the Mississippi is done by "still-fishing" methods—pole and line in the summer, and a "line rig" in winter. More fishermen, however, are beginning to use bait and fly casting equipment. Live baits, largely minnows or angleworms, are the usual lures. Artificial baits are used in some places. Those who fish for catfish use so-called "natural" materials, including dough balls, cheese, "stink baits," blood, shrimp, cut fish, etc. The kinds of fish caught vary with the bait used, and consequently the most popular bait in one locality will not be the same as the most popular bait in another place on the river.

For many years there have been a few summer hotels along the Upper Mississippi and modern cabin camps are appearing in ever increasing numbers along the banks of the river.

There is at least one town on the Upper Mississippi which has a summer festival in honor of the river and the fishing. Lansing, in northeastern Iowa, has a two day celebration in late July or early August called "Lansing Fish Days." A street carnival with booths operated by local organizations and a midway with ferris wheel and merry-go-round occupies Main Street. The most popular booth features fried fish sandwiches. In the evening, weather permitting, there is a "Venetian Night" performance in which there is a parade of torch-lighted boats around the bend in the river below Lansing. The Fish Days celebration has been held for about five or six years.

Although the intensive creel census information applies only to that portion of the river between Red Wing, Minnesota and Dubuque, Iowa, it is probably fairly typical of the sport fishing throughout the Upper Mississippi. The "Ol' Mississip" caters to the desires of both the most enthusiastic and scientific fisherman and to the cane-pole angler who likes to doze in the shade on the bank or drift on the slow current.

VIII

LEGISLATION AND INTERSTATE COOPERATION

The need for interstate cooperation and special legislation to solve the problems concerning the fishery resources of the Mississippi River has been evident to conservation workers from the earliest years. In his second Biennial Report (1877), B. F. Shaw, Fish Commissioner of Iowa, asserted that a law protecting the fish in the boundary rivers from seining, especially during spawning, was an absolute necessity if the fish were not to diminish greatly in numbers. He added that to be effective such a law would have to be common to all the states which border upon the rivers. He invited correspondence from the commissioners of other states bordering on the Mississippi and Missouri Rivers, with a view to working out such legislation.

In 1877, a meeting was held at which the western fish commissioners discussed the question of protective fish laws for the "great western rivers and lakes" (Fish Commission of Iowa, 1877). The deputy United States Fish Commissioner, Professor J. W. Milner, was present and was asked to examine the possibility and the constitutionality of federal control of waters which were common to several states.

Professor Milner reported that, according to precedent, the control of fishing would come under the police power of the state. However, artificial propagation had created new problems for which state laws were inadequate. The northern states might appropriate and spend money for propagating fish, and the southern states could, by allowing fish to be taken during spawning season, prevent the upper states from deriving any value from their propagation work. Professor Milner said that the desire for federal legislation had been so generally expressed that he thought it would be advisable for the state legislatures to call the attention of Congress to the matter. *"The whole question is in an undecided, little understood condition, and demands investigation and inquiry on the part of all interested"* (Fish Commission of Iowa, 1877).

The commercial fishermen presented many problems to the states. In 1894, George Delavan, the Fish Commissioner of Iowa, protested the setting of seines across the mouths of interior rivers by Mississippi River commercial fishermen. He said they did it to keep the fish in the Mississippi where they could seine them whenever they desired (Eleventh Biennial Report of the State Fish Commissioner of Iowa, 1896). The most difficult problem to solve was establishing jurisdiction over the boundary waters. In the Biennial Report of the Iowa Fish Commissioner in 1898, the Commissioner said that it was important that the jurisdiction of Iowa fish laws should be extended to the middle of the channel of the Mississippi. He said (p. 9) :

"Both Wisconsin and Illinois have laws prohibiting the seining of fish on their side of the channel, and the result is that the Iowa side of the river is seined constantly by market fishermen. The Mississippi river is the source of supply for all of Iowa's inland waters, and if the fish are allowed to be taken there without hindrance the supply for our rivers and lakes is necessarily cut short. In all the cities and towns on both sides of the river are to be found large numbers of men with miles of seines constantly draining Iowa's side of the river of fish that would ascend the interior rivers if let alone. Near the town of Sabula, on the Iowa shore, is a pretty bay in the river that is a natural place for fish to gather in. This fall in one haul of a seine in this bay by fishermen from Savannah, Ill., 800 wall-eyed pike weighing from two to five pounds were taken, besides a large number of fish of other varieties. If other states bordering on the Mississippi can prohibit this wholesale destruction of fish, Iowa can and should do it at the earliest opportunity."

This report was made in 1898 and, although reinforced by succeeding Commissioners, it was not until 1909 that the first license law was passed for Mississippi River fishermen in Iowa *(Laws of the Thirty Third General Assembly,* 1909, Chap. 155, Sec. 2). A license, renewable annually, was required of anyone seining any portion of boundary waters within the jurisdiction of Iowa. Size limits were placed on certain species (Bennett, 1926).

Between 1895 and 1925 each of the states established licenses for commercial and sport fishing in the Mississippi. Restrictions were also placed upon the gear (such as outlawing "shut-off nets"), upon the species which could be taken by commercial fisheries (reserving the centrarchids, yellow walleye, and yellow perch for sport fisheries), and upon the sizes of fish which could be kept. In general, the legal regulations have been less restrictive in Iowa than in the other states. Greenbank (1949) in reviewing the commercial catch per acre in various sections of the river, stated (pp. 3-4):

"It is to be noted that of the four sections, the two with the greatest yields were the Minnesota—Wisconsin section, where the regulations are the most stringent (fewest types of tackle permitted), and the Wisconsin—Iowa section, with perhaps the least stringent regulations of the four. It appears probable that the commercial fishing regulations have little to do with the actual take of fish in the Upper Mississippi."

Two questions concerning jurisdiction arose in regard to fishing in the river. The first question was concerned with how far the boundary waters extended. In 1893, a commercial fisherman was arrested while seining in Big Lake, a body of water three miles north of Lansing, Iowa. Big Lake was about one half mile west of the Mississippi River,

and west of the lake were two sloughs that connected with the Mississippi at a point northwest of Big Lake when there was a freshet sufficient to raise the water over the river banks. At times some water did overflow into Big Lake, but there was a question whether it came from the Mississippi or the Upper Iowa River. The defendant claimed that Big Lake was part of the Mississippi and, therefore, was not under the jurisdiction of the fish commissioners. At the time of his arrest, he had in his possession between 3,000 and 4,000 pounds of game fish. The fisherman was convicted of violation of the law which prohibited seining in public waters in Iowa, but on appeal to the district court, the judgment was overruled and Big Lake was declared a part of the Mississippi River. The region was immediately overrun with seiners who apparently threatened to deplete the supply of fish. The State appealed the case to the Iowa Supreme Court which decided in the State's favor. The opinion stated that boundary waters referred to that part of the river which was clearly part of the navigable river and did not refer to bodies of water which were wholly within the territory of one state (Fish Commission of Iowa, 1896). A similar decision was reached in another case in 1909 (Reports of the Supreme Court of Iowa, CXLIV, pp. 492-502).

The second problem concerning jurisdiction arose when some states had laws for boundary waters and others did not. This was the question of how far a state's jurisdiction extended. The Illinois law requiring a license to seine in the Mississippi was declared unconstitutional, whereupon some Iowa fishermen conceived the idea of seining just east of the middle of the channel and thus escaping the necessity of buying an Iowa license (Bennett, 1926, p. 391). One such fisherman was arrested. However, the District Court of Des Moines County, where the case was tried, discharged the defendant on the grounds that the Iowa officials had no jurisdiction whatever over fishing beyond the middle of the main channel.

The State appealed to the Supreme Court of Iowa and on June 25, 1912, a decision was handed down reversing the judgment of the lower court (Iowa, CLV, 672-678, "State v. Meyers."). It was held by the Supreme Court that the concurrent jurisdiction which was granted to Iowa and Illinois by Congress in the enabling acts which made them states empowered Iowa to enforce its fishing laws even if the violations took place on the Illinois side of the channel. The Court recognized that this opinion raised serious problems, but felt that no other decision was justified by the facts. The Court specifically disagreed with a ruling of the Supreme Court of Wisconsin (Roberts v. Fullerton, 117 Wisconsin 222), which held that the jurisdiction over fishing which could be exercised by Wisconsin and Minnesota extended only so far as the boundary water was definitely within the territorial limits of the state.

Many river fishermen when arrested by state game wardens con-

tested their arrests, saying that the states had no jurisdiction over the river since it was a "government water." Stringham (1919) said that this belief was entirely without legal basis, and where state wardens had diligently enforced the law the fishermen did not seriously hold that opinion. *"It arises chiefly from laxity past or present, on the part of State officials"* (Stringham, 1919, pp. 6-8). The Mississippi River, according to Stringham, is a "govermnent" river in the sense that questions of navigation are subject to the jurisdiction of the Federal Government. But at an early date, 1855, in the case of Smith v. Maryland, the Supreme Court of the United States decided that the States may protect the fisheries of navigable waters. The national government was interested, however, in the adequate protection of fish, since it yearly planted young fry in the river.

Some conservation officials, such as Eben Cobb (1916) of Minnesota, advocated that the Federal Government should have control of the fish in interstate waters, just as it has control of the birds which fly over them, since what one state does or neglects to do can have a profound effect on the fishery resources of bordering states. However, the laws protecting the birds are effective only as they relate to enforcement of the treaties with Canada and Mexico.

When licensing of Mississippi River fishermen began, non-resident licenses were more expensive than resident licenses. The Missouri Fish Commissioner in 1908 advocated the repeal of the fifteen-dollar non-resident sport fishing license fee, because Illinois might retaliate. In that way, he said, thousands of the citizens of St. Louis would be deprived of recreation, since there were no good fishing spots on the Missouri side of the river. By paying ten cents for carfare, St. Louis residents could go to the Illinois side of the river to fish (Report of the Board of Fish Commissioners of the State of Missouri, 1909). In the Iowa Code of 1913 (Supplement to the Code of Iowa, 1913, Sec. 2574a), non-resident commercial fishing licenses were made the same price as resident, but a $200 bond was required of non-residents.

Most of the states on the Upper Mississippi River now have reciprocal agreements for sport fishing on the river and a fisherman does not have to have a license in more than one of the states to fish in the border waters. These reciprocal agreements often also include provisions that restrictions on the catch shall be the same on both sides of the interstate line. Probably the first interstate reciprocal fishing law on the Mississippi River was passed in 1913 by Minnesota and Wisconsin. The Minnesota Board of Game and Fish Commissioners (1914, p. 5) stated: *"We are pleased to say that the legislature at its last session, in conjunction with the Wisconsin legislature, passed a reciprocal interstate fishing law, which applies to. . the Mississippi River where it forms the boundary between the states of Minnesota and Wisconsin. This has done away with the friction which shad existed between the two states regarding the boundary line."*

The mussel fishery, especially as it declined so rapidly, gave a great impetus to interstate cooperation. One of the greatest problems in the administration of the mussel fishery was that the control of the waters was in the hands of the various states and not in the Federal Government. In his report of 1898, Dr. Hugh Smith (1899) stated that the perpetuation of the mussel fishery depended wholly on the joint action of the states concerned, and that the Federal Government and the U. S. Fish Commission were entirely without jurisdiction. Twenty years later (Fisheries Circular, No. 43, Feb., 1919), Dr. Smith, then Commissioner of Fisheries, made substantially the same statement. A bill was drafted by the Bureau of Fisheries as a basis for concurrent legislation by the various states. As the mussels began to disappear more and more rapidly, the states did take some action, independently at first, through licenses and closed seasons (Stringham, 1917).

In 1923, a conference among representatives of Illinois, Iowa, Wisconsin, and the U. S. Bureau of Fisheries resulted in closing certain areas of the Mississippi to the taking of mussels for a period of five years. Illinois and Wisconsin closed areas directly opposite those closed by Iowa so that each area extended from shore to shore (Fish and Game Warden of Iowa, 1925).

Efforts to control the pollution of the river have led to interstate cooperation in studies of methods of abatement. After many years of effort, it became apparent that the Federal Government would have to take some action toward solution of the problem, and, after much agitation by the Izaak Walton League and other groups, a Water Pollution Act (Public Law 845) was passed in 1948 (Schneberger, 1950).

Groups of fishermen, who felt that the fluctuation of the water level in the navigation pools was detrimental to fishing, organized the "Anti-drawdown Congress." Many sportsmen's clubs in Minnesota and Wisconsin joined this organization and took credit for having regulations put in force limiting the speed and amount of the drawdowns in the navigation pools (Rice, May 2, 1949).

The Upper Mississippi Valley Water Use Council was a group appointed by the governors of Minnesota, Iowa, Wisconsin, and Illinois. It was organized in 1945 and dissolved in 1950. Sportsmen's groups felt that on the questions of "water use" the Council always sided with the Army Engineers rather than with the sportsmen (Rice, June 26, 1946 and Feb. 19, 1950).

The need for uniform regulation of the fisheries by the various states and the need for cooperative action on many problems affecting the fish and wildlife of the river were important factors leading to the organization of the Upper Mississippi River Conservation Committee in 1943. The Committee has initiated many research projects and has provided a valuable mass of information upon which the regulations, still by the individual states, can be based. Its work stands as an example of the cooperative effort through which our natural resources can be more properly managed.

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It is with deep regret that I have learned of the death of W. E. Albert of Lansing, Iowa. My husband and I spent several pleasant days with him in the summer of 1952, during Lansing's summer festival called Fish Days. Mr. Albert introduced me to several fishermen of the Lansing area, who gave me a few colorful bits out of the earlier days of Mississippi River fishing. He was most generous with his time, and, having lived his life on the river, he had much to offer in the way of local color and valuable information about the fishing industry. No one else had made me realize quite so clearly the tremendous hold the river has on those who live along its banks. If Mr. Albert could have written this history, it would have been a much fuller and richer story than I have been able to make it.

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BIBLIOGRAPHICAL NOTES

THE LITERATURE CITED CANNOT COVER ALL THE SOURCES OF INFORMATION TO WHOM THE AUTHOR IS INDEBTED IN A STUDY SUCH AS THIS. MUCH OF THE BACKGROUND MATERIAL AND GENERAL INFORMATION HAS COME FROM INTERVIEWS, NEWSPAPERS, MAGAZINES, AND BOOKS NOT SPECIFICALLY CITED. SOME OF THESE ARE INDICATED BELOW:

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Mr. G. H. Gill, former Superintendent of U. S. Fish Hatchery at Manchester, Iowa, October 1949.
Mr. "Pete" Mays, fisherman, New Albin, Iowa, July, 1952.
Mr. Bob Moxham, commercial fisherman, Charleston, Missouri, September, 1950.
Miss Rose and Mr. Jake Ehrlich, Ehrlich Fisheries, Lansing, Iowa, July, 1952.
Mr. Nord, manager, Nord-Buffum Button Company, Louisiana, Missouri, September, 1950.
Mr. Eldon Saeugling, Superintendent, U. S. Fishery Station, Guttenburg, Iowa, May, 1950.
Mr. and Mrs. Ed Saylor, commercial fishermen, Guttenburg, Iowa, May, 1950.
Mr. Fred Schafer, grocer, Lansing, Iowa, July, 1952.
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and others.

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1910. Biennial report of the Commissioners of Fisheries of Wisconsin for the years 1909 and 1910.
1899. Biennial report of the Commissioners of Fisheries and the State Fish and Game Warden of Wisconsin, 1897-1898.
1949. Twenty-first biennial report of the Wisconsin State Conservation Commission for the fiscal years ending June 30, 1947 and June 30, 1948.

Wisconsin State Board of Health. 1927. Stream pollution in Wisconsin. A joint report of the Conservation Commission and State Board of Health of Wisconsin concerning activities in the control of Stream Pollution, from July 1, 1925, to December 31, 1926.