

Tritigonia verrucosa FROM WHICH TWENTY-EIGHT ROUGH BLANKS HAVE BEEN CUT. (*Tritigonia verrucosa*) FROM WHICH TWENTY-EIGHT ROUGH BLANKS HAVE BEEN CUT. Natural size.

THE MUSSEL FISHERY AND PEARL-BUTTON INDUSTRY OF THE MISSISSIPPI RIVER.

BY HUGH M. SMITH.

Although the business of manufacturing buttons from the shells of our native fresh-water mussels is of quite recent origin, it has already attained comparatively large proportions and seems destined to have still further growth. The fear is entertained, however, that, through indiscriminate methods, the supply of mussels may be so seriously reduced that the continuance of the fishery and the dependent manufacturing may be imperiled. The possibility of the early exhaustion of the mussel beds in that part of the Mississippi River which is in Iowa and Illinois has led a number of interested persons to request the United States Fish Commission to make an investigation of the subject, as this is the section in which the business is most extensive and has been longest established. In compliance with this request the writer was assigned to the investigation and visited the centers of the business in July, 1898. The present report is based on the observations then made.

The principal inquiries were conducted at Muscatine, Iowa, the leading center of the button industry, although some other important places, as Clinton and Davenport, were also visited. Many fishermen and manufacturers were consulted with regard to the important features of the business. The manufacturers, without exception, furnished detailed statistics concerning their work. Those whom it was not practicable to personally visit were corresponded with, and, with few exceptions, they have supplied the desired data.

The statistics herein presented relate to the calendar year 1897 and to the first six months of 1898, when there was a remarkable development of the button-making business. The figures are the first which have been collected covering this industry, and will prove useful in determining the changes which may take place in subsequent years.

The investigation naturally embraced the following general topics, which are hereafter specially considered: (1) The mussels utilized in button-making, (2) the mussel fishery, and (3) the button industry. To these is added a chapter embodying a statement of the measures that appear to be demanded in order that the stability of the industry may be maintained.

THE MUSSELS UTILIZED IN BUTTON-MAKING.

While there are probably 400 species of mussels found in the Mississippi River and its tributaries, comparatively few are now utilized in or are adapted to button-making. The requirements of a shell, from the button-maker's standpoint, are sufficient thickness, a uniform color of the surface and various strata of the shell, and a degree of toughness that will withstand the necessary treatment without cracking or splitting.

Thin-shelled mussels are absolutely useless for button-making. Even if originally as thick as a button, the necessary grinding and polishing reduce them to mere wafers. The preferred color is white, but cream-colored shells are also employed. Shells with pink, purple, yellow, or salmon-colored nacre are not suitable, as the color fades with age and is apt to be not uniform. Certain shells that satisfactorily combine thickness and color are nevertheless useless, because they are soft or brittle and break easily during manufacture. Dead shells that have been exposed for a long time to the action of air or water also become useless for button-making.

Mr. Charles T. Simpson, of the department of mollusks of the United States National Museum, has courteously supplied the newly revised scientific names for the mussels used in the button industry, and has given valuable information concerning this family of mollusks, with which he is so familiar. For a very interesting and timely article on the fresh-water mussels, considered from the standpoint of the biologist, reference is made to Mr. Simpson's paper entitled "The pearly fresh-water mussels of the United States, their habits, enemies, and diseases, with suggestions for their protection," published in the Bulletin of the U. S. Fish Commission for 1898.

Coincident with the establishment of the mussel fishery and button industry in Iowa and Illinois, there has arisen a new popular nomenclature for the mussels or "clams" utilized. The names applied by the fishermen and manufacturers have some reference to the color or shape of the shells. Originally quite local, they are now generally applied throughout the whole stretch of river in which fishing is done.

The principal species of mussel in the Mississippi River used in button-making is *Quadrula ebena*, generally known as the "niggerhead." This species has the general shape of a common round clam (*Venus mercenaria*), and is characterized by a very thick and heavy shell, with a black or dark-brown outside skin and a glistening white interior, the latter color being uniform through the thickness of the shell. It is of relatively small size, the maximum being only 4½ or 5 inches for the greatest outside diameter and the average about 3 inches. Many less than 2 inches wide are also unnecessarily destroyed. It is often found over immense areas, preferring muddy sand and muddy gravel bottom, but also frequenting sandy bottom. In some places a form of this mussel known as the "mud niggerhead" is sparingly used. It is found on muddy bottom, and has a thicker shell and a more intensely black epidermis than the common form.

Several abundant species of mussels resembling the niggerhead in shape, but differing from it in having tubercles or excrescences on the outside of the valves, are locally known as "warty-backs" or "warty-back niggerheads" (*Quadrula pustulosa*; *Q. metanevra*). They have very little value for buttons, the warts causing the shell to crack during cutting.

Another species of this class that is abundant, but only sparingly used, is the "bullhead" (*Pleurobema axopus*). It is found with the "niggerhead," has a thick shell with a blackish-brown skin and a white interior, and externally presents several radiating ridges. It is of little value, as the shell is brittle and cracks in cutting, and the buttons also split in facing and drilling.

There are several kinds of mussels known along the Mississippi as "sand shells." The most abundant and important of these is the "yellow sand shell" or "yellow-back" (*Lampsilis anodontoides*), which has a bright yellowish-brown epidermis and a faintly cream-colored interior. Another species with a black exterior is known as the "black sand shell" (*Lampsilis rectus*). The sand shells are found chiefly on sandy

bottom, and are reported to be quite active, moving toward the shores in the morning and back toward the channel in the evening, making conspicuous tracks on the bottom. These mussels, which are long and narrow, reach a length of 6 inches, and are highly valued in button-making.

A smaller species is the "slough sand shell" (*Lampsilis fallaciosus*), which seems to be most common in or near the mouths of narrow arms of the river, especially coves that extend into islands. It is less generally distributed in the river than the "yellow sand shell," occurs in much smaller beds, and is now quite scarce in most places where extensive fishing has been carried on. It is considered very good for buttons, having a beautiful pearly color and uniform thickness. It has been practically caught out in the vicinity of Muscatine, near which place a bed yielded 10 tons a few years ago and ceased to exist.

Ranking next to the sand shells in abundance is the species known as "mucket," "mouket," or "mougat" (*Lampsilis ligamentinus*). It attains a length of 6 inches, but the average size of those utilized is only about 4 inches. It has a dark-brown exterior and a creamy-white nacre. Only second-class buttons are made from it, as the front part of the shell is thin and the back part brittle. New factory hands are usually set to work on this species.

One of the best mussels for buttons is known as the "deerhorn" or "buckhorn" (*Tritogonia verrucosa*). It is not abundant, and the supply is irregular and uncertain. It attains a large size; examples over 9 inches long have been taken from the Iowa River, and in the Mississippi it reaches a length of 6 inches or over, the average being about 5 inches.

A rare but very desirable mussel is the species locally known as the "butterfly" (*Plagiola securis*), in allusion to the shape of the valves. The flat shell is of small size, but thick and of a fine color. The epidermis is reddish-brown, marked by dark radiating lines. In 100 tons of miscellaneous shells from the Mississippi River, in the Muscatine section, there are likely to be only a few hundred pounds of "butterflies." In the Illinois, Ohio, and some other tributaries of the Mississippi, this mussel is abundant.

A mussel not very highly regarded by the button-maker, but sometimes used, is the so-called "blue-point" (*Quadrula undulata*). It has a large, thick shell, with a wavy exterior; the nacre at one end is usually of a bluish or purplish color, in contrast with the white surface of the remaining part. The chief objection to its employment in button-making is the lack of uniformity in color.

Another species not highly regarded is the "hatchet-back," or "hackle-back," (*Symphynota complanata*). This is a large, black mussel with a projecting wing. The valves are thin and of an undesirable color, and only a very small section of each is suitable for buttons.

Several species of "pocketbook" clams (*Lampsilis capax* and *L. ventricosus*) are more or less abundant and yield a good button of medium thickness. They are characterized by having rounded valves of great depth.

Nearly all the tributaries of the Mississippi in this section contain mussels in some abundance, but no mussel fishing is done in them. The Iowa and Cedar rivers, for instance, have a good supply of large "muckets" and large "blue-points," which are the principal species; also pink and white "hatchet-backs," a few fine "sand shells," a very few "niggerheads" and "pocketbooks," and some extra large "deer-

horns" of good quality, the last-named constituting about 10 per cent of the mussels adapted for button-making. There is no fishing now carried on in these streams, although there was a little six years ago. It does not pay to ship the shells, and there is no local demand. In the Skunk and Des Moines rivers there are some shells that might be utilized, but they are not sufficiently abundant to maintain a large factory. Among others there are small, brittle "muckets" of little value, a few desirable "pocketbooks" and "sand shells," and some very good medium-sized "deer-horns." In Rock River, Illinois, there is reported an enormous growth of "muckets" which are not utilized.

A number of animals prey on the mussels, among them the muskrat, the mink, and the raccoon, the first named being especially destructive. Catfish are also said to eat mussels. Hogs are known to be very injurious in some parts of the country.

Physical causes are undoubtedly responsible for extensive destruction of mussels. During freshets mud and sand are deposited on the beds and bury the mussels. Shifting sand-bars are also known to cover up beds. The fishermen sometimes find extensive beds of dead shells which appear to have recently been uncovered by the current. During freshets, when the streams find new channels, many mussels are carried from their beds and left dry when the water subsides. Droughts also are liable to expose mussel beds and cause much destruction.

Pollution of the water by refuse from cities and manufacturing establishments is perhaps the most serious menace to the mussel beds, next to the operations of the fishermen. Certain kinds of refuse are very destructive and are capable of killing practically every mussel with which they come in contact.

Fishermen and button-makers report a considerable percentage of "niggerheads" with the beaks partly gone, the remaining portion being softened and easily split into laminae. Accompanying this condition there is often a softening of the other parts of the shell in spots. Only the larger (older) shells are thus affected, and it appears to represent a natural decay due to age. Buttons made from such a shell are soft, and are apt to split up into layers in the course of manufacture.

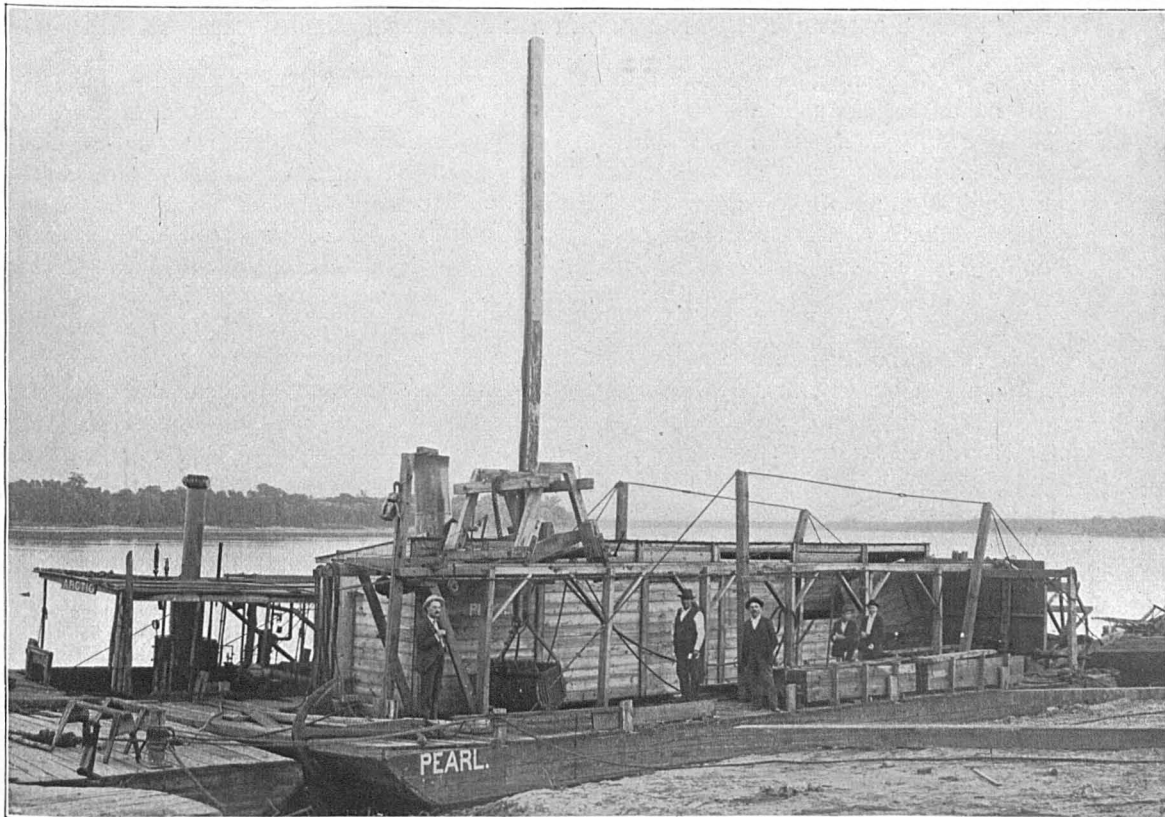
For much interesting information concerning the habits, spawning, mode of dispersal in the streams, rate of growth, etc., of the mussels, the paper of Mr. Simpson should be consulted.

THE MUSSEL FISHERY.

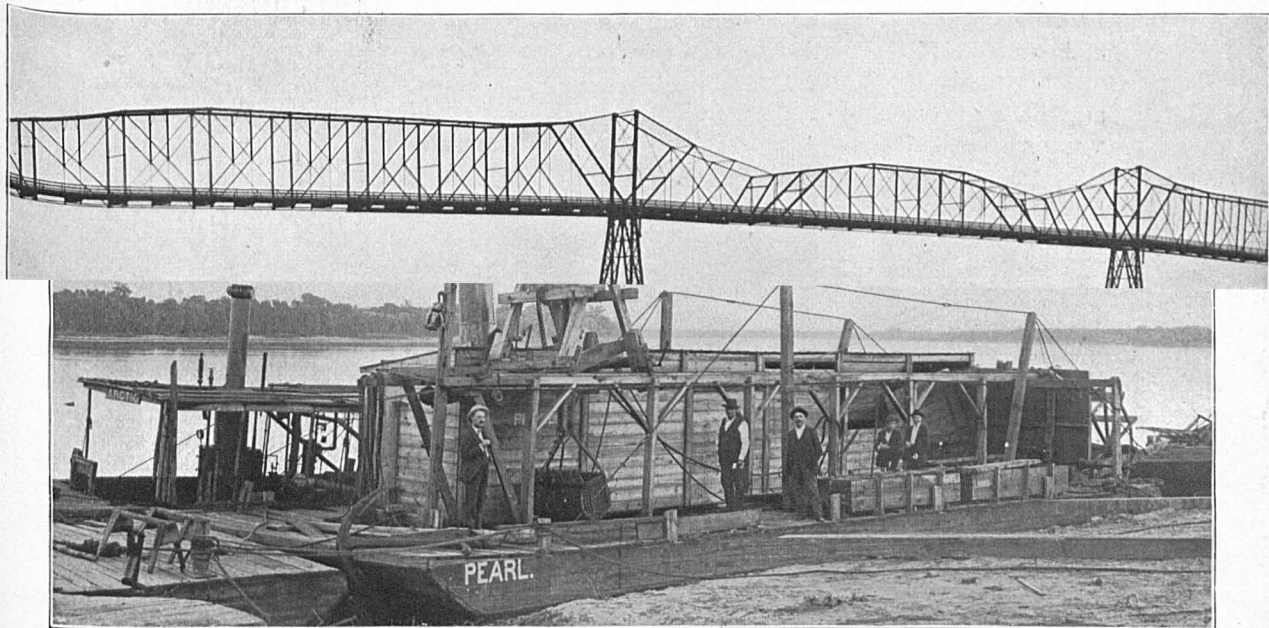
THE FISHERMEN.

The mussel fishermen in the region under consideration are mostly people who have been engaged in other branches of fishing, or who, as boatmen, etc., are familiar with the river. Many of them depend on mussel fishing for their livelihood and follow it throughout the year, but others seek mussels only when their regular work is suspended. Thus, in winter especially, the ranks of the regular mussel fishermen are considerably augmented by sawmill hands, farm hands, and others. Owing to the increase in the mussel fishery during the past two or three years, it is said that many farmers have had difficulty in obtaining men to work on their farms.

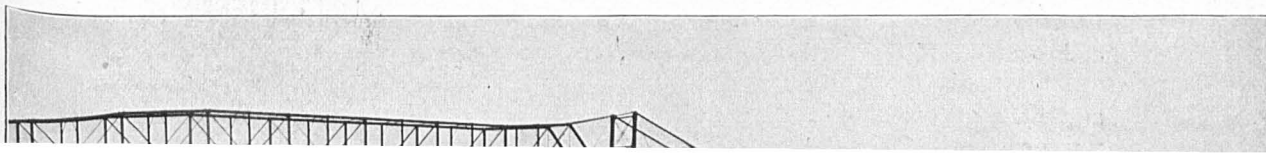
It is reported that in 1897 there were, between Burlington and Clinton, in Iowa, over 300 persons who engaged in taking mussels to sell to the button manufacturers at the various towns along that part of the Mississippi. In 1898, the number



STEAM DREDGE, SPECIALLY CONSTRUCTED FOR THE MUSSEL FISHERY, MUSCATINE, IOWA.



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of fishermen between Fort Madison and Sabula was estimated at 1,000. As many of the fishermen have no permanent headquarters, but move from place to place, it is difficult to obtain an accurate statement of their number.

The leading fishing and button-manufacturing center is Muscatine, at which place in 1898 there were about 100 mussel fishermen. On an extensive and productive bed, as many as 150 to 300 fishermen may be engaged at one time.

In view of the small amount and inexpensive character of the apparatus required to prosecute the fishery, the comparative ease with which the mussels are taken, and the little experience required, mussel fishing is regarded with favor by many men, as they are readily able to get their catch to market and dispose of it, receiving cash in payment. When they find a good mussel-bed they sometimes make \$30 or more per week. The average earnings, however, are considerably less, at this time probably being less than \$10 per week. Some days \$2 or \$3 will be made, but inclement weather prevents fishing and reduces the average.

The income of the mussel fishermen is now generally less than formerly, owing to the increase in the number of fishermen, the lower prices received for their catch, and the reduced abundance of the mussels.

APPARATUS AND METHODS.

Owing to the comparatively shoal water in which mussels are found, they may be gathered with less difficulty than is ordinarily encountered in taking shellfish. Furthermore, the shoalness of the Mississippi makes every part of it accessible to the fishermen and renders the exhaustion of the beds more certain, speedy, and complete.

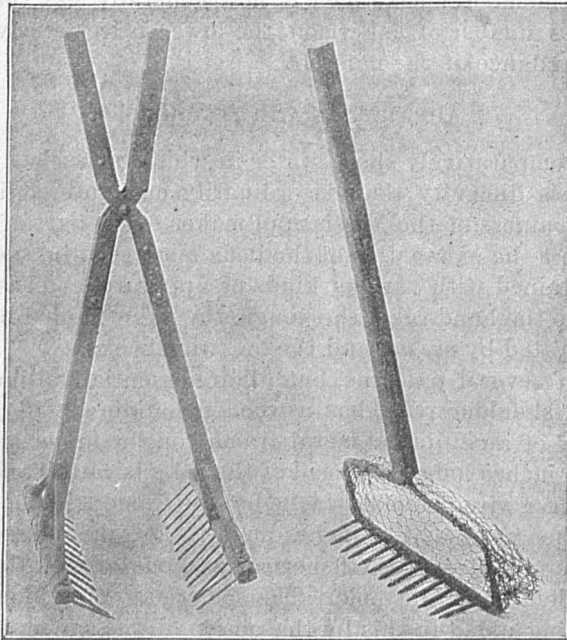
Mussels are obtained with various kinds of apparatus. Those which have been or are now in use are the hand-rake, the tongs, the rake hauled by means of a windlass, the dredge operated by steam, and the bar with hooks.

The rakes are of several patterns, but all are essentially alike. The commonest form, known as the shoulder rake, has a wooden handle 14, 16, 18, or 20 feet long, attached to one side of an elliptical metal frame; on the under side of the frame are 12 to 14 iron teeth 5 inches long; the head of the rake is converted into a kind of basket by a piece of coarse wire netting attached to the frame; the mouth of the basket is 8 inches deep, 6 inches wide, and 16 inches long. The rake is used from an anchored boat. The handle is placed over the fisherman's shoulder, and the rake is placed upstream to the full length of the pole. The fisherman then slowly works the rake toward his boat, being aided in this by the action of the current on a broad wooden piece nailed crosswise near the base of the handle. The rake is then lifted perpendicularly from the water and the mussels are emptied into the boat. This rake is also used through the ice.

The tongs, which along parts of the Mississippi are called "scissor rakes," are similar to the ordinary oyster and clam tongs. They are used in water as deep as 15 feet, but usually in only 10 feet or less. The value of the tongs is \$3 or \$3.50 each.

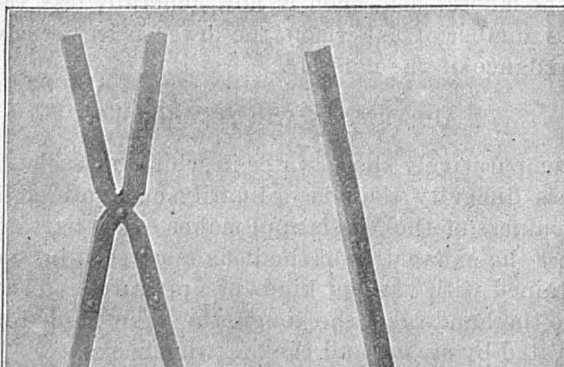
The dredge or rake used with a windlass, locally known as the "drag rake," is larger and heavier than the shoulder rake and of different shape. It has a rectangular iron framework covered with narrow strips of hoop iron placed about an inch apart. The apparatus has the appearance of a flat cage, with long teeth projecting obliquely downward from the anterior lower margin. The rake, with the windlass and rope, is worth about \$25.

A large steam scow for taking mussels, owned at Muscatine, is unique. It is provided with a huge rake or dredge operated by steam. The rake is made of iron and weighs 500 pounds. It is 48 inches long, 18 inches wide, and 30 inches deep, and is provided with twenty-five 8-inch teeth. The rake is operated in a recess or slot in the bottom of one side of the scow. This recess is 5 feet wide and 40 feet long, and is surmounted by a framework with a double track, on which the heavy timbers supporting the rake slide while the rake is being dragged along the bottom. A perpendicular beam is attached to the rake, by means of which it is raised and lowered and dragged from the forward end of the recess. The length of this beam is such that the rake may be used in water as deep as 22 feet. This vessel carries a crew of four men and cost several thousand dollars. It has not been sufficiently used to demonstrate whether it can be profitably employed with the mussels so much less abundant and more scattered than formerly.



Tongs and rake used in mussel fishery of Mississippi River.

(Only a part of handles is shown.) It has not been sufficiently used to demonstrate whether it can be profitably employed with the mussels so much less abundant and more scattered than formerly.



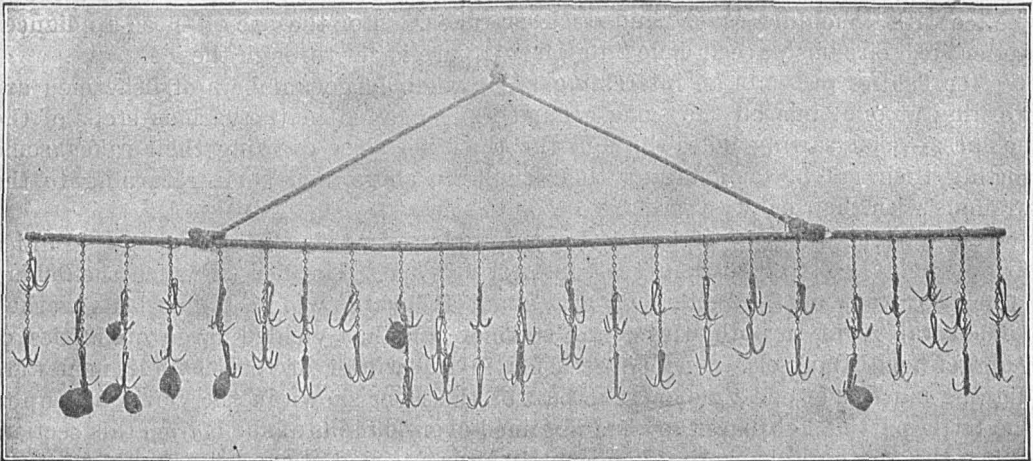
each end of the bar, forming a bridle, to which is fastened the bail, or the rope by which the dredge is pulled. This rope is about 25 feet long. The quantity of hooks varies with the length of the bar and the number in each string. A 6-foot bar, with 3 hooks on each string, the strings being 6 inches apart, would have 39 hooks. A 7½-foot bar, such as the one herewith illustrated, with only 2 hooks on a string and the strings 4 or 5 inches apart, would contain 46 hooks.

In allusion to the shape of the hooks, this apparatus is locally known as the "crowfoot" dredge or rake.

The usual outfit for a fisherman is two dredges, valued at \$1.50 to \$2 a pair.

A modification of this appliance consists in putting wooden wheels, 6 inches in diameter, on the end of the iron bar, so that the bar will clear the bottom as the dredge is hauled, and will not disturb the beds.

This apparatus depends for its action on the habits of the mussels. They rest on the bottom, or partly buried in the mud or sand, with the free margin of their shells

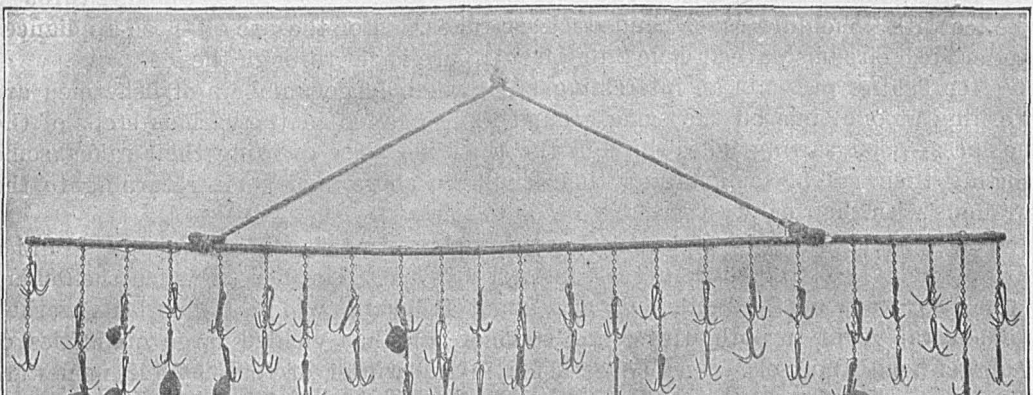


"Crowfoot" dredge or grapple, showing mussels attached to the hooks.

turned upstream and with their shells separated to admit the water, laden with oxygen and food. When touched, they quickly close their shells, and if a foreign body is interposed between the valves it is tightly grasped and retained.

The method of using this appliance is as follows: The fisherman throws it overboard from his boat and allows the boat to slowly drift downstream. As the dredge is hauled, and will not disturb the beds, the latter quickly close on the hooks.

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remarkably effective it is. Often when the mussels are abundant almost every prong will have a mussel on it, and two or three are sometimes caught on one prong. The writer saw 60 marketable mussels taken on 39 hooks, and has often observed large clusters of shells on a single string of hooks. When the beds of mussels are compact one man can take 800 to 1,000 pounds of "niggerheads" in a day, and a case is reported where 2,200 pounds were obtained by one man in 10 hours. The average daily catch at present, however, is probably not over 500 pounds.

On account of the cheapness and efficiency of this apparatus, together with the ease of operating it, it has become very popular with the fishermen and has practically superseded all other appliances. It is said to reduce the labor of fishing about half, as compared with the shoulder rake and dredge. Another advantage is that it takes only live shells, while the other appliances are often loaded with dead shells, trash, etc. By its use a larger area can be covered and fishing done on grounds that could not be profitably worked by other means, owing to the shells being much scattered.

After sufficient ice forms on the river there is considerable mussel fishing through the ice with "shoulder rakes" and "scissor rakes." For the use of these appliances under such circumstances a hole 2 to 6 feet square is cut through the ice.

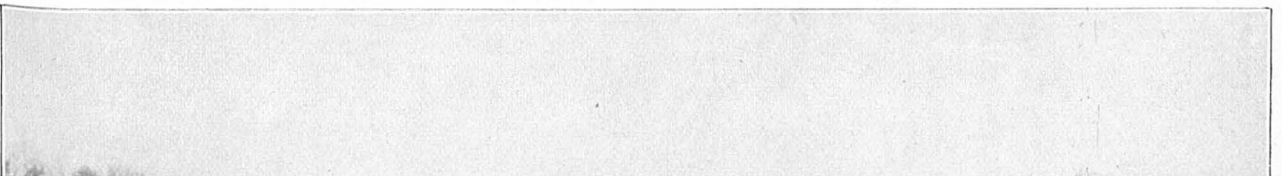
Ice fishing presents an interesting scene when large numbers of fishermen are working at one time on the same ground and engaged in the various steps of the business—some sawing holes through the thick ice, some drawing their rakes, some sorting their catch, some taking their catch to shore, and some returning to the grounds with their empty vessels.

Among the illustrations herewith presented are two showing men engaged in ice fishing near Leclaire, Iowa, in the winter of 1898-99. The bed on which the fishing is being done is nearly a mile long and about 100 yards wide. It has been worked for several years, in both winter and summer, and has yielded large quantities of "nigger-head" mussels. On one occasion, in the winter of 1898-99, 142 men were digging mussels at one time on that part of the river shown in the views, and up to the latter part of February they had obtained over 500 tons of shells from this section. When the photographs were taken, shortly after a period of excessively cold weather, when fishing was suspended, only a few of the fishermen had returned to work. The ice is 12 to 28 inches thick, and the water over the bed is 8 to 14 feet deep. One man is seen sawing a hole through the thickest ice. Some men work alone, others in pairs. When two operate together, one uses the rake while the other sorts the mussels, frequent change of duty being made, as the hauling of the rake is quite arduous. One of the long-handled rakes, with fine, long tines, is shown. One man can dig or rake from 600 to 800 pounds of shells daily on such a bed. They are sorted in pails, emptied into box sleds, and hauled over the ice to the place where they are weighed and paid for.

The fishermen who use the shoulder rake or "crowfoot" have small flat-bottomed skiffs, worth from \$5 to \$10 each. Those employing dredges have a barge or flat boat with deck room sufficient for the manipulation of the windlass and dredge, and also a temporary cabin. Such a boat is valued at \$20 or more.

Some fishermen have large house-boats, which are moored at places convenient to the fishing-grounds and serve as temporary homes. The value of such boats is about \$200. Usually a fisherman and his family will occupy one boat, and live very comfortably during the fishing season.





The fishermen have crude, oblong tanks, located at some convenient place on shore, made of sheet iron, capable of holding water. A fire is built under the tanks, and the mussels are boiled 10 or 15 minutes in order to kill them and permit the extraction of the fleshy part. Under the influence of the heat the shells open, and the meats either fall out or are readily picked out by hand. After being thus prepared, the shells are loaded in sacks and sent by steamer to the button factory, or they may be taken to market in the fisherman's boat. Sometimes large scows are loaded with shells at a camp and towed to the factory town by a tug. Shells are also sold on the shore to buyers representing the local button-makers or factories in other States.

A view is presented showing a part of a "boiling-out" shed, at LeClaire, Iowa, where many of the fishermen disposed of their catch in the winter of 1898-99. The shed, which is 40 feet square, has three furnaces, on which are huge boiling pans, each holding 20 bushels of mussels. The mussels are boiled for about 15 minutes and then thrown out on tables, when the meat easily comes from the shells as they are broken or pulled apart and thrown into a heap. When photographed, this shed contained 200 tons of cleaned shells, while outside were 350 tons in heaps.

The fishermen make no use of the "meats" removed from the shells in cooking. In some places the meats are eagerly sought by farmers who go to the fishing shores, collect this waste product without cost, and feed it to hogs and poultry. It seems probable that the fishermen might add materially to the proceeds of their fishing by finding a market for this waste. The quantity is, in the aggregate, large, amounting in the first half of 1898 to fully 500 tons. From a ton of niggerhead mussels as taken from the water over 300 pounds of meats may be obtained. The food value of the mussels is practically *nil*, and only limited quantities are used for bait in line fishing. It is possible, however, that a market for the meats, in a salted condition, may be found in the Atlantic coast States, where salt clams are extensively employed in the line fisheries for cod, haddock, hake, and other ocean fishes. Recently, considerable quantities of fresh-water mussels, taken from ponds in southern Massachusetts, have been salted and sold to cod fishermen at a good price (\$4 or \$5 per barrel of 200 pounds). Even at \$3 per barrel, the Mississippi River fishermen could well afford to send their waste mussel-meats by freight to the coast. It is not known just what effect cooking has on the quality of the meats, but it is thought that this process does not seriously impair their value as bait.

THE FISHING SEASON.

In the early days of the industry, fishing was carried on from about August to December, but of late it has been conducted throughout the year, even after the river is frozen. The principal fishing, however, is still done in late summer and fall, when the river is lowest. On one bed, near Muscatine, 50 persons were at times engaged in ice fishing in the winter of 1897-98, and on other large beds as many as 200 persons have been employed at one time. Ice fishing is of comparatively recent origin, having been first carried on only during the winter of 1896-97. The quality of the shells is better in cold weather for the purpose of the button-maker. The mussels are then less brittle, while warm weather, with prolonged exposure in boats, makes them brittle.

The question of a close season for the mussel fishery, in order to afford the mussels a respite from incessant hunting, especially during their spawning time, is now being agitated and is hereinafter discussed.

THE FISHING-GROUNDS.

The Iowa and Illinois button factories located on the Mississippi River obtain their supply of shells from grounds which extend from Fort Madison, Iowa, to Sabula, Iowa. This section of the river is 167 miles in length, following its sinuosities, although the distance in an air line between the points named is only 118 miles. The average breadth of the river is two-fifths of a mile, the maximum unobstructed width being about 1 mile, just north of Campbell Island, between Leclaire and Davenport.

This part of the Mississippi is quite shallow at the mean stage of the water. The usual depth in the channel is 12 to 14 feet, the deepest water being only 33 feet. On either side of the channel the bottom generally slopes gradually to the shores. In the latter part of summer and the early fall the depth is always reduced by the diminution in the volume of water coming downstream, while in winter, spring, and early summer the river is swollen by rains and melting snows; there being every season a freshet of greater or less severity.

The character of the bottom varies greatly, but it is usually sandy, sand-bars and low sandy islands being common features. There are, however, more or less extensive areas of muddy bottom, and in some places rocky or gravelly bottom prevails.

Owing to the shoalness of the river and the character of its bed, the annual freshets produce marked changes in the bottom topography. These changes have an important relation to the mussel beds, which are sometimes entirely swept away and sometimes completely destroyed by being covered with sand or mud; such beds of dead shells are not infrequently found by the fishermen when subsequent freshets have swept off the overlying sand or mud.

Throughout the river section mentioned, mussels are found in scattered or in condensed bodies. The natural tendency of some of the species is to form more or less dense beds, while others seem to be uniformly distributed. Considered as a whole, this part of the Mississippi River is undoubtedly one of the most favored sections of the United States as regards abundance and variety of mussels adapted for buttons. By far the greater portion is taken from special areas on which they are more abundant and more closely grouped than in other places. Such beds, which are sometimes of great extent, have their principal axis lengthwise the river, and are often quite narrow.

On some grounds practically all of the mussels are of one species, while on others several species may be mixed in varying quantities. The largest and most compact beds are formed of "niggerheads" and "muckets." On new grounds the "niggerheads" are sometimes so thickly disposed that practically the entire bottom over a large area is covered, and the shells are often found several layers deep. In holes or depressions in the sandy or muddy bottom "niggerheads" are often discovered in thick piles, and many bushels may be taken from one of these holes.

Owing to the crowding of the mussels, some of the fishermen think that fishing is beneficial to the beds, in that it spreads the mussels over a larger area and permits a more rapid growth and increase of those that remain. There is a popular belief among some of the fishermen that depleted beds may be reestablished in three years—that is, the mussels are thought to reach a marketable size in three years after the young are hatched. Most of the fishermen and manufacturers, however, have no definite knowledge as to the rate of growth, although all think it more rapid than is actually the case.

Among the more noteworthy mussel beds that have been worked in the past few years are the following:

In 1896 a bed of "niggerheads" and "muckets" in front of Muscatine, about 2 miles long and $\frac{1}{4}$ mile wide, yielded 500 tons of shells.

A very large bed was discovered near New Boston, Ill., a few years ago. It was about $1\frac{1}{2}$ miles long and 60 rods wide, with the shells very thickly disposed. It is reported that fully 10,000 tons of shells, chiefly "niggerheads" and "muckets," with a few "sand shells," were taken during the past three years. The number of mussels represented by this enormous quantity was probably not less than 100,000,000.

There is a very large and productive bed 3 or 4 miles below Clinton, on the Illinois side of the river; it is a mile long and several hundred feet wide. The shells in places are reported to be several feet deep, but the greater part of those lying deepest are dead.

One of the most noted beds in the upper river is near Camanche.

In 1898 the principal mussel fishing was done between Davenport and Clinton. While other parts of the river were also resorted to by the fishermen, the bulk of the catch was from beds in the upper river that had not been so actively worked as those in the vicinity of Muscatine and other places as far down as Burlington.

In July, 1898, when the writer visited the river, a number of camps of "clam" fishermen were met with between Davenport and Clinton. One of these, located directly on the bank of the river, was quite extensive and presented an interesting scene as the numerous boats brought in the shells from the adjacent river, and as the catch was being cooked and piled up at the headquarters of each crew. The principal apparatus in use along this section was the grapple, although a few shoulder rakes and drag rakes were also seen.

The shells for the Davenport factories come chiefly from the vicinity of Princeton, where there is a great abundance of mussels. In May, 1898, the fishermen were restricted in bringing in their catch, as the factories could not handle all of it. Although there are a good many "muckets" in the river in the vicinity of Davenport, there was in 1898 no demand for them.

Reference has already been made to the productive bed near LeClaire, Iowa.

DEPLETION OF THE GROUNDS AND ITS CAUSES.

Although the mussel fishery along this section of the Mississippi River is under ten years old and in most places began within the past two or three years, it has already had a pronounced influence on the productivity of the mussel beds and bids fair to lead to serious consequences to the capital invested in the button industry of the States of Iowa and Illinois. Throughout this stretch of river, wherever fishing has been at all regular or active, there has been a more or less marked reduction in the abundance of mussels of all kinds utilized in making buttons, and in some localities the depletion of the grounds has been almost complete.

The manufacturers generally recognize the present tendency toward the practical exhaustion of the available grounds, and feel the need of some action that will place the industry on a permanent basis. The fishermen also, however loath they may be to acknowledge it, have practical evidence that the mussel grounds are capable of depletion and are being greatly reduced in productiveness. The many persons financially interested in the mussel fishery and the button industry are very desirous that appropriate measures be taken to insure the existence of a substantial business of this

kind. Suspension of the industry along this part of the river—which is not a remote contingency—would prove a calamity to many of the communities.

The present condition of the principal grounds, before referred to, illustrates the serious effects of indiscriminate fishing and emphasizes the solicitude felt by the button-makers and others for the maintenance of the supply. Thus, the large bed in front of Muscatine was unable to stand the drain of one year's fishing, and now yields few mussels. The New Boston bed, reported to be the best in this section of the Mississippi, was so assiduously worked that it was completely exhausted, few fishermen resorting to it in 1898. The abundance of mussels was incredible, and yet a few seasons' operations depleted this ground. It is reported that when fishing first began on this bed some men took as much as 1,500 to 2,000 pounds of shells in a day's fishing, but now a fisherman would have difficulty in getting that quantity in a week.

Between Burlington and Davenport the condition of the beds is such that many fishermen no longer resort to them, but go to grounds that have been worked for a shorter time. Up to July, 1898, there had been no noteworthy decrease in the mussels in the river near Davenport, but the fishery there is still quite young, and the manufacturers are anticipating a decrease.

Owing to the very slow growth* of the mussels and the comparative facility with which the fishermen exhaust new grounds, there is no reason to believe that depleted beds will recuperate while the grounds on which fishing is now being done continue to be productive, so the indications are that the conditions will steadily grow more unsatisfactory.

The history of the fishery up to this time shows the disregard for the future which has come to be regarded as characteristic of fishermen. The decrease in the mussel supply has been brought about by several practices. The principal factor has been the activity of fishing operations. Not only have large quantities of mussels been taken from the bed at one time, but the fishing has been so incessant that no opportunity has been afforded the beds to recuperate. The shoalness of the water has made it possible to thoroughly scour almost every foot of ground. The high water that prevails during a part of the year was formerly a protection to mussels at an important time, but it is so no longer, as the present apparatus may be used at all times when a boat can be managed.

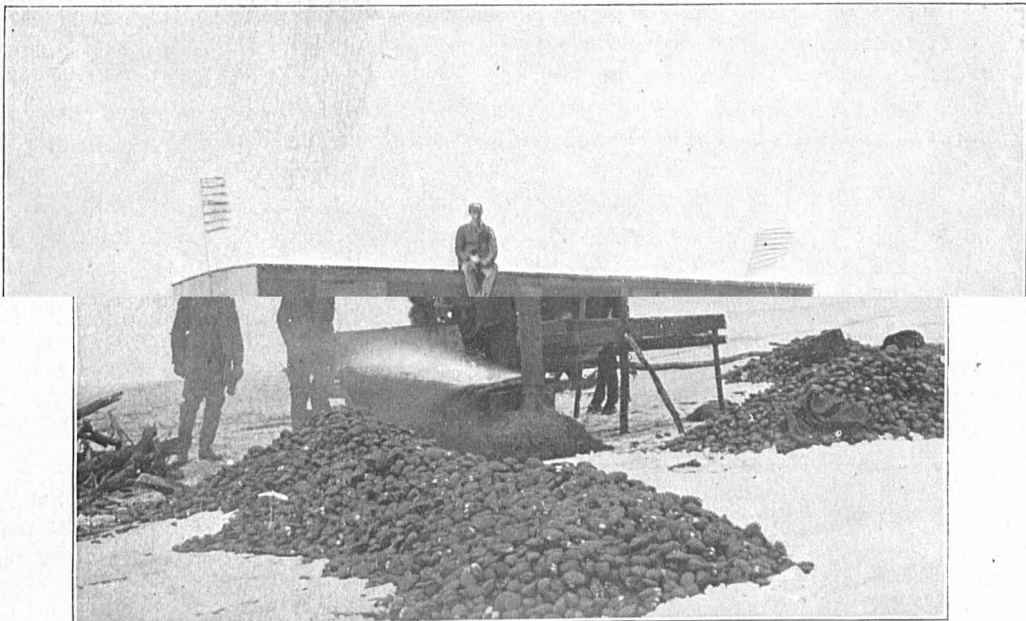
The failure of the fishermen to suspend their operations immediately prior to and during the spawning season of the principal species of mussels has undoubtedly had a serious effect on the supply. This question has been freely agitated in the local press, and the sentiment among most of those interested, including fishermen, favors protection for the mussels at this critical time. Under the impression that the spawning occurs in spring, they advocate a close time at that season.

A good many fishermen and manufacturers expressed the view that ice fishing is unduly destructive, owing to the fact that enormous quantities of mussels—some as small as 1 inch in diameter—are brought up and left on the ice to freeze and die. These, in open water, would drop back or be thrown back as the catch is removed from the rakes or tongs, or when the boats are cleaned. Aside from this damage, many think the shells should be unmolested during the winter, when they are more

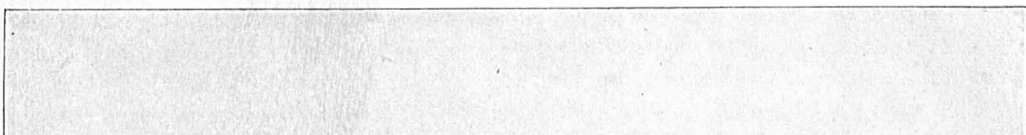
* For example, the time required for a "niggerhead" mussel, under normal conditions, to reach a size of 3 inches is not less than 10 years and is perhaps generally as much as 12 years, while a shell $4\frac{1}{2}$ inches in diameter is from 15 to 18 years old.



COOKING MUSSELS TO REMOVE THE MEATS. SHORE OF THE MISSISSIPPI IN MIDWINTER.



COOKING MUSSELS TO REMOVE THE MEATS. SHORE OF THE MISSISSIPPI IN MIDWINTER.



or less dormant. Many persons expressed themselves as favoring the prohibition of ice fishing.

The suspension of the ice fishing and spring fishing would, of course, keep many fishermen out of employment at a time when they need ready money. There is little reason to believe, however, that it would reduce their annual earnings, even at the outset, while ultimately it would undoubtedly prove financially beneficial. The manufacturers report that no injury would result to the button business from their failure to receive shells during a closed season, as they could—as most of them now do—lay in sufficient supply in summer and fall to keep the factories running.

Not the least injurious feature of the fishery is the gathering of small mussels for market and the incidental destruction of small shells that are not utilized, but left on the banks or the ice to die. The testimony of the button manufacturers and the evidence afforded by their shell-heaps indicate that there are comparatively large quantities of immature mussels taken. This practice depends to some extent on the depletion of the grounds of the larger mussels, necessitating the gathering of the smaller ones to make a fair catch, but also on the indifference of the fishermen to the great injury thus done the mussel supply. The manufacturers are, of course, equally indiscreet in continuing to purchase lots of small shells, and a few of them refuse to do so, but it is generally not feasible to exclude the small shells mixed with the larger ones. The desire that there should be some restriction on the size of the shells taken is quite general among the manufacturers. However, as long as the fishermen bring them in, the manufacturers will buy them. Some of the button-makers, indeed, prefer comparatively small shells—say niggerheads $2\frac{1}{4}$ or $2\frac{1}{2}$ inches in diameter—for the reason that their quality is as good as or better than many of the large shells, and the waste is relatively less.

If no mussels smaller than $2\frac{1}{2}$, $2\frac{3}{4}$, or even 2 inches in diameter were gathered, the matter would not be so serious, although it must be acknowledged that shells less than $2\frac{1}{2}$ inches in diameter are very small, but many mussels only an inch in diameter have been sacrificed, and some of the manufacturers report that considerable numbers of shells no larger than a nickel or a dime are brought in. From a niggerhead shell an inch or less in diameter, only one medium-sized blank may be sawed. Thus, for two buttons, a mussel is sacrificed which, in a few years, would have yielded 8 to 12 times as many.

PRICES RECEIVED FOR SHELLS.

The prices which the fishermen receive for shells vary considerably, depending on the supply and demand. The size and kind of the shells also affect the price. The standard shell is the niggerhead. In 1897 the market value of this species in Muscatine ranged from 40 to 62 cents per 100 pounds. Shells were cheaper in 1898 than at any previous time, but in February, 1898, there was a scarcity of shells at the factories, prices went up to \$18 and \$20 per ton, and many fishermen were thus induced to enter the business for the first time, and the supply was soon in excess of the demand. By July, 1898, the prices had fallen as low as 30 cents per 100 pounds for small "niggerhead" shells and 35 cents for large ones.

The ruling prices for other shells in 1897 were as follows, per 100 pounds: Sand shells, \$1.70; muckets, 30 cents; deerhorns, \$2; pocketbooks, 50 cents. The other species—bluepoints, butterflies, bullheads, hatchet-backs, etc.—are seldom sold sepa-

rately, but are mixed with some of the shells named. Slough sand shells bring \$1.50 to \$2 per 100 pounds, but few have been obtained in recent years.

When fishermen dispose of their catch without removing the meats, the prices usually range a fourth lower than for cleaned shells; thus, when "niggerheads," as usually sold, are bringing 40 cents per 100 pounds, those disposed of as they come from the water are worth only 30 cents.

It has been determined by actual count that in 100 pounds of the average size "sand shells" there are about 900 to 912 valves or half-shells. In 100 pounds of "niggerheads" of the average size now taken there are 970 to 1,000 valves. These numbers seem high when the thick and heavy shell of this species is considered, but they have been amply verified and indicate the inordinate use of small mussels to which reference has been made. In 100 pounds of "muckets" there are 800 valves. Thus, in a ton of "niggerheads" there are 9,700 to 10,000 complete mussels represented, in a ton of "muckets" 8,000 mussels, and in a ton of "sand shells" from 9,000 to 9,120 mussels.

SHIPMENT OF MUSSELS TO OTHER STATES.

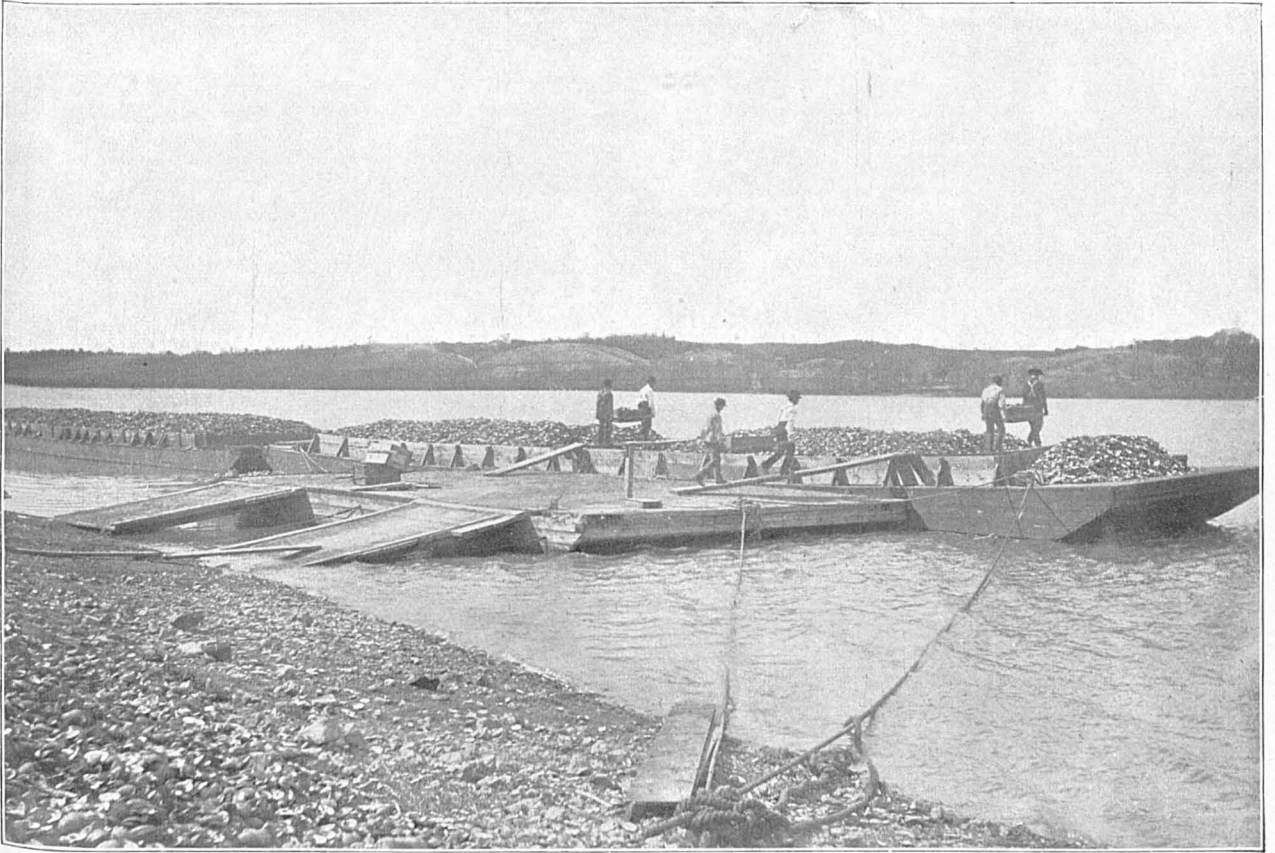
In 1897 a rather important business sprung up at Muscatine consisting in the purchase of large quantities of shells from the local fishermen and their shipment by train to button-manufacturers both east and west of the Mississippi. The business is restricted to "niggerheads" and "yellow-backs." In 1897 the fishermen received on an average 40 cents per 100 pounds for the "niggerheads" and \$1.50 per 100 pounds for the "yellow-backs." In 1898, up to July 1, the prices were 35 cents and \$1, respectively. The shells are mostly shipped in carload lots, although a few are sent in smaller quantities packed in sacks. The amount of the shipments in the first six months of 1898, namely, about 14 carloads, was almost as large as during the entire season of 1897, when the equivalent of 14½ carloads was shipped, but the cost value of the shells was much less in 1898.

Shipments of shells are also made from other places on the Mississippi, and the business seems to be growing. In the winter of 1898-99 one buyer at LeClaire, Iowa, had a contract for 1,000 tons of shells to be shipped to New York.

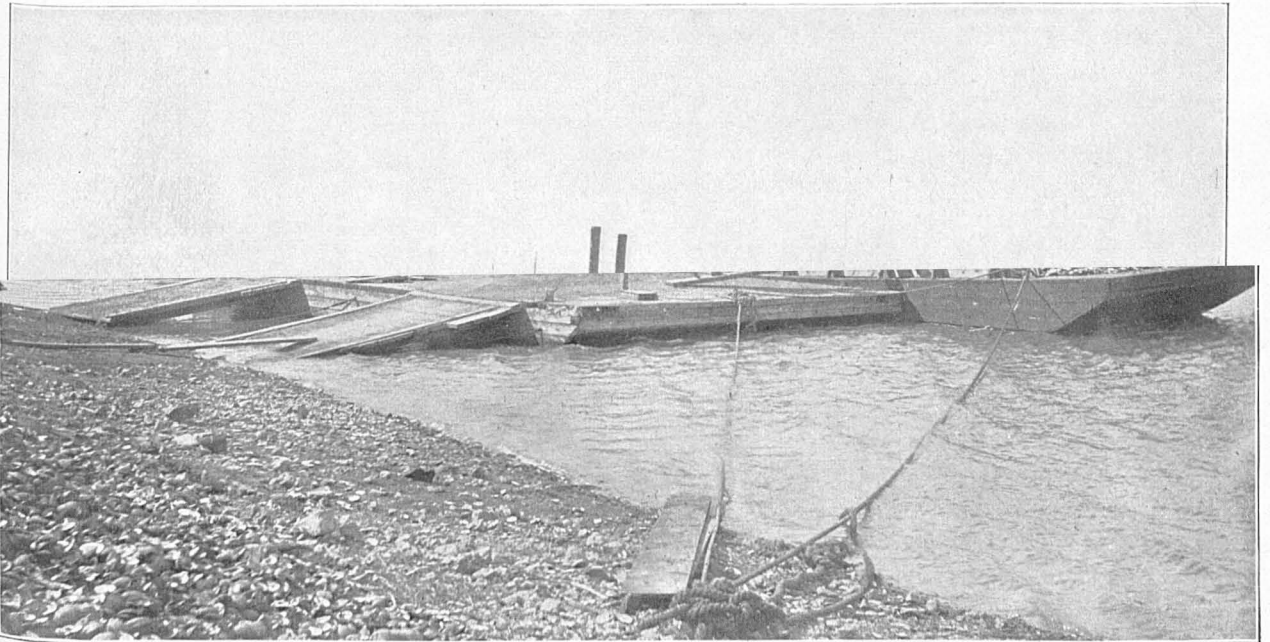
Other States to which mussel shells have been sent from this part of the Mississippi are Michigan, Pennsylvania, Nebraska, New Jersey, in addition to a number of places in Iowa and Illinois not on the river.

The extent of the business at Muscatine in 1897 and in 1898 to July 1 is shown in the following table:

Year.	Kinds of shells.	Shipped east.		Shipped west.		Total.	
		Pounds.	Cost.	Pounds.	Cost.	Pounds.	Cost.
1897.....	Niggerheads.....	160,000	\$640	100,000	\$400	260,000	\$1,040
	Sand shells.....	170,000	2,550	.....	.....	170,000	2,550
	Total.....	330,000	3,190	100,000	400	430,000	3,590
1898 (to July 1)....	Niggerheads.....	300,000	1,050	60,000	210	360,000	1,260
	Sand shells.....	60,000	600	.....	.....	60,000	600
	Total.....	360,000	1,650	60,000	210	420,000	1,860



LOADING MUSSELS ON SCOWS AT LECLAIRE, IOWA, FOR TRANSPORTATION TO MUSCATINE.



LOADING MUSSELS ON SCOWS AT LECLAIRE, IOWA, FOR TRANSPORTATION TO MUSCATINE.

RECENT STATISTICS OF THE MUSSEL OUTPUT.

The quantities of mussel shells which were taken by the fishermen and sold to the button manufacturers in 1897 and the first six months of 1898 are shown in the following table. The total output is seen to have been 3,817 tons in 1897 and 3,950.74 tons in the first half of 1898. For these quantities the fishermen received \$43,998 and \$38,868, respectively.

The predominating importance of the niggerhead mussels (*Quadrula ebena*) is apparent, as these constituted 89 per cent of the yield in the first-named year and 94 per cent in the latter. The sand shells are second in importance, and are taken in larger quantities than all the remaining species combined.

Quantities and values of mussels sold by the mussel fishermen on the Mississippi River in 1897 and 1898.

Species.	Tons.	Value.
1897.		
Niggerheads	3,414.00	\$34,149
Sand shells	299.00	8,960
Muckets	81.75	287
All others	22.25	302
Total	3,817.00	43,998
1898 (first 6 months).		
Niggerheads	3,709.00	\$36,891
Sand shells	102.00	1,662
Muckets	26.25	154
All others	12.80	161
Total	3,950.74	38,868

In 1897 the average prices per ton received by the fishermen were \$10 for niggerheads, \$29.97 for sand shells, \$3.51 for muckets, and \$27.06 for all others, the general average price being \$11.53. In 1898 the prices were \$9.95 for niggerheads, \$16.20 for sand shells, \$5.87 for muckets, and \$12.50 for the others, with a general average of \$9.84.

THE BUTTON INDUSTRY.

ORIGIN AND PRESENT IMPORTANCE OF THE BUTTON INDUSTRY.

The manufacture of buttons from the native fresh-water shells began in the United States in 1891, the inauguration of the business being made possible by the high tariff on imported buttons imposed by the tariff bill of 1890. This levied a duty of 2½ cents per line per gross on shell buttons and 25 per cent ad valorem. In the customs act of 1897 the tariff on pearl buttons was fixed at 1½ cents per line per gross and 15 per cent ad valorem.

The first person to engage in this business was Mr. J. F. Boepple, who had for many years been similarly engaged in Hamburg, Germany. On account of an abundance of suitable mussels in its vicinity, Muscatine, Iowa, was selected as the site of the first factory and has now become an important center for button manufacturing. Other towns on the Mississippi and its tributaries from time to time established works, until in 1898 there were 21 communities in Iowa and Illinois in which buttons

were made. A remarkable development of the business was witnessed in 1898, no less than 36 factories being established during the first six months of that year.

It is reported that some time before the establishment of a permanent industry at Muscatine, an effort was made to maintain a factory on the Tennessee River; this, however, was unsuccessful and was soon abandoned.

Button-making is one of the principal businesses along that part of the Mississippi between Iowa and Illinois. It gives employment to large numbers of people, who would otherwise be idle, at what are considered good wages for such labor. It also supports a very important fishery, at which many hundred persons make a living. Besides the people thus directly connected with the business, many others in more than a score of towns are benefited, including merchants, machinists, boatmen, draymen, and transportation companies.

Other important features of the Mississippi River button industry are the transformation of a hitherto useless product into a valuable commodity and placing it on the markets at reasonable prices.

NUMBER, LOCATION, AND DESCRIPTION OF THE FACTORIES.

During 1897 and 1898 (to July 1) button factories were located at the following places on the Mississippi River, in Iowa and Illinois, the lowermost point being Fort Madison, Iowa, and the uppermost Sabula, Iowa:

Iowa: Buffalo, Clinton, Davenport, Fort Madison, Muscatine, and Sabula.

Illinois: Albany, Andalusia, Cordova, Keithsburg, New Boston, Oquawka, and Port Byron.

The following table shows the growth of the button industry of the section of the Mississippi in question, the number of factories established each year being given:

Years when button factories were established on the Mississippi River in Iowa and Illinois.

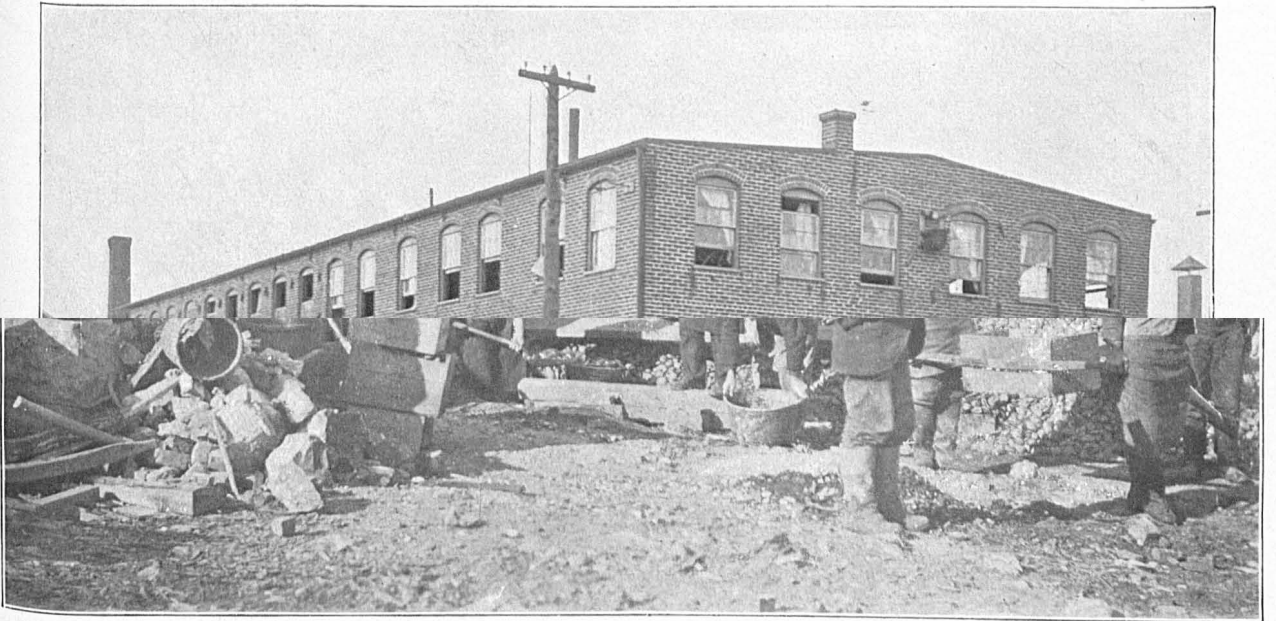
Year.	Muscatine, Iowa.		Other places in Iowa.		Places in Illinois.		Total.	
	Complete plants.	Saw works.	Complete plants.	Saw works.	Complete plants.	Saw works.	Complete plants.	Saw works.
1891.....	1						1	
1892.....								
1893.....								
1894.....								
1895.....	1		2				3	
1896.....								
1897.....	3	3	1		1	1	5	4
1898 (to July 1) ..		25	2	2		7	2	34
Total	5	28	5	2	1	8	11	38

By far the larger number of these factories are small establishments at which only "rough blanks" are sawed; many of them should hardly be dignified by being called factories. In 1898 only 11 of them, located in Muscatine, Davenport, Clinton, Sabula, and Keithsburg, were plants where finished buttons were made.

At Muscatine there were 8 button-making establishments in operation in 1897, 6 of which began work in that year. By July 1, 1898, there were 33 factories in operation, and in the latter half of the year a number of others were opened. At other places named there were 5 factories in 1897, and 16 in the first half of 1898.



A GLIMPSE OF THE MUSSEL BUSINESS AT LECLAIRE, IOWA, WHERE THE MUSSELS ARE BOUGHT FROM THE FISHERMEN, CLEANED, AND THE SHELLS SENT BY RAIL AND WATER TO BUTTON FACTORIES. In the pile shown there are 350 tons of "niggerhead" shells.



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The number of factories in the various towns in operation in 1897 and 1898 are shown in the following table:

Location.	1897.			1898 (to July 1).		
	Complete works.	Saw works.	Total.	Complete works.	Saw works.	Total.
Muscatine, Iowa.....	5	3	8	5	28	33
Davenport, Iowa.....	2		2	2		2
Clinton, Iowa.....				1		1
Buffalo, Iowa.....					1	1
Fort Madison, Iowa.....					1	1
Sabula, Iowa.....	1		1	2		2
New Boston, Illinois.....					1	1
Keithsburg, Illinois.....	1	1	2	1	2	3
Oquawka, Illinois.....					1	1
Cordova, Illinois.....					1	1
Port Byron, Illinois.....					1	1
Andalusia, Illinois.....					1	1
Albany, Illinois.....					1	1
Total.....	9	4	13	11	38	49

In addition to the foregoing factories along the Mississippi in Iowa and Illinois, to which this report especially relates, in 1898 there were factories at the following places in those States at which mussel shells from the Mississippi were utilized: Cedar Rapids, Vinton, and Charles City, Iowa, on the Cedar River; Coralville, Iowa, on the Iowa River; West Liberty, in the western part of Muscatine County, Iowa; What Cheer, Keokuk County, Iowa; Oskaloosa, Mahaska County, Iowa, and Aledo, Mercer County, Illinois. Other button factories which get all or part of their raw material from the Mississippi are reported to be located in Chicago, Illinois; Cleveland and Cincinnati, Ohio; Janesville, Wisconsin, and Omaha, Nebraska.

The factories at which the finished buttons are made are, as a rule, specially constructed 2-story brick buildings of considerable size, having a cost value of \$5,000 to \$30,000, which sum includes land, buildings, machinery, and general equipment. A few of them occupy parts of mills or machine shops. Some of the plants at which only blanks are sawed are also in special brick or wooden buildings, but most of the "saw works" are in connection with machine shops or in improvised outbuildings of private residences, some of the smaller ones being in simple sheds. A single room is sufficient for the mere sawing of the rough blanks, but the various steps in the manufacture of the complete buttons necessitate a number of rooms and make the factory a very elaborate establishment, with the heavier machinery and rougher work on the first floor, and the different finishing processes on the upper floor.

The essential work at all the factories is done by machinery. At all the larger and many of the smaller establishments, the motive power is steam or electricity; some obtain their electric power from the city electric plant, some have independent dynamos, some have steam engines, and some use the power of adjoining machine shops or mills. A gasoline engine, of 2 or 3 horsepower, furnishes the motivity for the saws at several of the small works, and foot power is also employed in a few places.

BUTTON-MAKING MACHINERY.

The business of supplying the factories with the necessary special machinery has become very important in Muscatine. The facility with which the cutting machines may be obtained and their comparatively small cost have been leading factors in the establishment of many of the button factories. At some large machine shops

practically the entire work now consists in making and repairing apparatus used in button manufacturing and mussel fishing.

The following, taken from a Muscatine paper, illustrates the cost of the necessary machinery and the apparent profits of the machinists:

As so much has been said regarding the cost of producing pearl buttons and so little about the cost of the necessary machinery required in their manufacture, attention is called to the following schedule, figuring on a 10-saw basis.

The cost of machinery and the price that it has been selling for allow a very handsome profit, and the business is now looked on as a money-making proposition, which is not overdone as some lines, but affords an opening for new concerns to engage in.

Grinding machine:		Cutting machine:	
Casting	\$3.50	Castings	\$2.80
Steel .....	.30	Steel .....	.30
Machine screws .....	.15	Machine screws .....	.10
Machinist, 10 hours work	2.00	Machinist, 15 hours work	3.00
Helper, 10 hours' work	1.00	Helper, 15 hours' work	1.50
Emery wheel	4.00		
Fan	5.00	Total	7.70
Automatic beveling machine	22.50	Ten cutting machines	\$77.00
Total	38.45	Drilling machine:	
Two grinding machines with automatic beveling connection	\$76.90	Casting	4.00
Turning machine:		Steel .....	.60
Casting	4.00	Machine screws .....	.30
Steel .....	.60	Machinist, 20 hours' work	4.00
Machine screws .....	.30	Helper	2.00
Machinist, 20 hours' work	4.00	Total	10.90
Helper, 20 hours' work	2.00	Five drilling machines	54.50
Automatic tool sharpener and emery wheel	2.70	One sorting machine, comprising the rollers and cups	27.50
Total	13.60	Shafting, pulleys, and belting	123.60
Five turning machines	68.00	Polishing fixtures, consisting of tumblers, urns, etc	60.00
		One sizing and grading machine	19.50
		Total outfit	506.40

Cutting machines that cost \$7.70 generally sell for \$28. The cost of a 10-saw plant complete, \$506.40; running expenses of manufacturer to produce this from raw material, \$60; total, \$566.40. Usual selling price for such an outfit as described above, from \$2,500 to \$3,000.

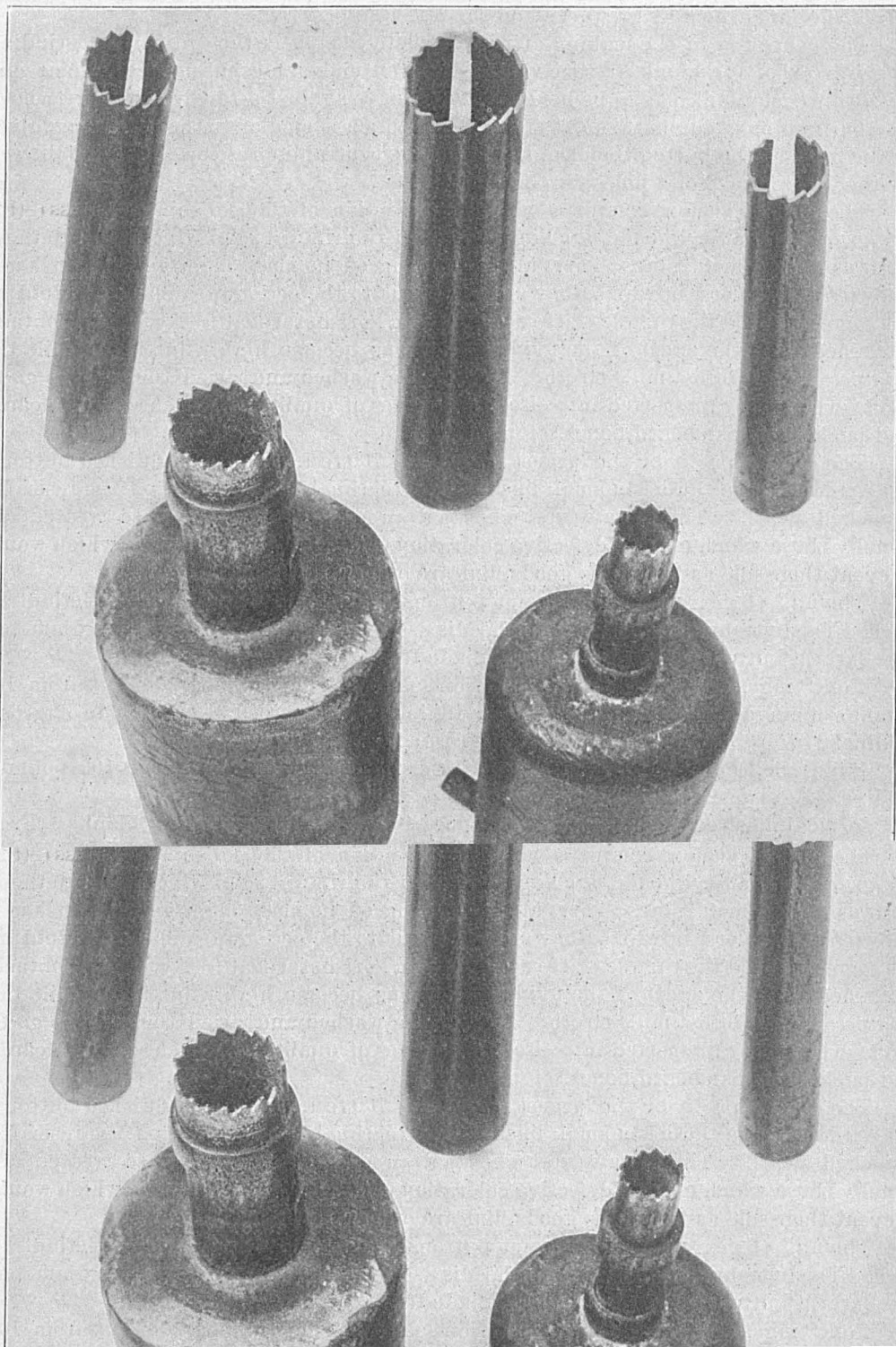
METHODS PURSUED IN THE BUTTON INDUSTRY.

The mussel shells, as purchased from the fishermen, are hauled from the boats to the factories in drays or wagons either owned or hired by the manufacturers or in vehicles belonging to the fishermen. At the factory the shells are stored in covered sheds, the different kinds usually being kept in separate bins. Preparatory to being used, the shells are sorted into sizes by boys. Usually three sizes of "niggerheads" are recognized. Another preliminary step is the soaking of the sorted shells in barrels of fresh water for three to six days to render them less brittle. Even when only a few hours out of the river the shells become dry and brittle. It is necessary that they be used while wet, otherwise they crumble or split under the saw.

The next step is the cutting or sawing of the rough blanks. Each cutter has a pile of selected shells at hand, and, in the large factories, is kept supplied by boys. Niggerhead shells are usually held with special pliers while being cut; these grasp the circumference of the shell and enable cutters to retain it fast while holding the shell at right angles to saw. Some sawers have the hand gloved or mittened, and use no pliers or pincers. At the more extensive plants a fine jet of water plays on the shell, as the saw revolves, in order to prevent the formation of dust and to keep the shell cool. The dust is very irritating to the respiratory passages and eyes of the

cutters, and at some of the factories it is drawn into a tube by a current of air. The cutters in the smaller works often cover the mouth and nose with a cloth.

The saws are made of flat steel strips about 2 inches wide, and of various lengths corresponding to the sizes of the buttons. These strips, after being provided with fine teeth along one of the sides, are accurately bent into a cylindrical form and



In all branches of the button industry a gross is considered as consisting of 14 dozen, in order to make allowance for the imperfect or defective buttons that are liable to be produced at every stage of the business from the cutting of the rough blanks to the sewing of the finished buttons on cards.

By far the largest number of factories produce only rough blanks, which are sold to a local finishing plant or sent to large concerns in the East, some of which have established their own "saw works" on the Mississippi.

The next step in the making of the complete button is the dressing or grinding of the back of the blank, to remove the skin and make an even surface. To accomplish this each blank has to be held with the finger against a revolving emery wheel.

Turning or facing is the next step. This, which is similar to the preceding, gives to the front of the button its form, including the central depression. This is followed by the drilling of 2 or 4 holes for the thread.

The button is now complete with the exception of the polishing process; this brings out the natural luster which has been lost in grinding, and which gives to these buttons their chief value. The buttons are placed in mass in large wooden kegs, known as tumblers, in which they are subjected to the action of a chemical fluid at the same time that the tumblers are revolving on a horizontal shaft. By mutual contact, combined with the effect of the fluid, the buttons become highly lustrous, while the fluid is churned into a milky froth. After being washed and dried the buttons go to rooms where they are sorted into sizes and grades of quality, and then sewed on cards and packed in pasteboard boxes.

The daily capacity of the largest factories is 700 to 1,000 gross of finished buttons.

At Muscatine there is a small business in treating buttons to make them resemble "smoked pearl." This is a secret chemical process. The buttons so treated are usually those which exhibit defective coloration, such as yellow blotches, which would prevent their sale as first-class goods, but are otherwise perfect.

The unit of measure of the size of buttons is the line, which is one-fortieth of an inch. The buttons manufactured on the Mississippi are from 12 to 45 lines in diameter. The largest buttons (40 to 45 lines) are made from "niggerheads."

Following are the quantities of various-sized blanks that may be cut from 100 pounds of average-sized "niggerheads": 16-line, 28 to 34 gross; 18-line, 30 to 32 gross; 20-line, 24 to 29 gross; 22-line, 15 to 20 gross; 24-line, 12 to 15 gross.

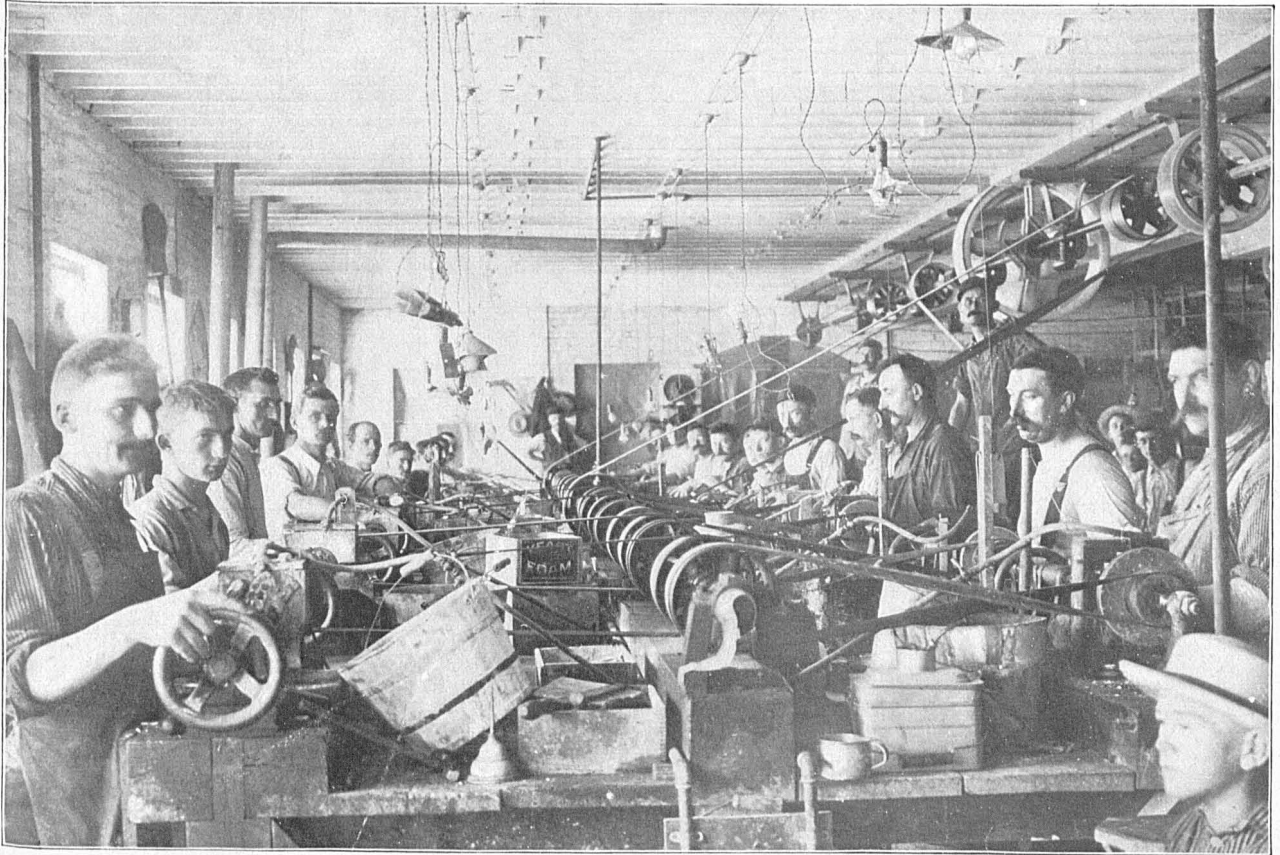
Sand shells of medium size and thickness yield the following, per 100 pounds: 20-line, 64 gross; 26-line, 31 gross.

A medium-sized "niggerhead" produces 4 or 5 18-line or 20-line blanks. From the large shells 8 or 10 blanks may be cut. Sand shells average 12 20-line buttons. Larger sand shells yield 16 to 20 buttons. The largest deerhorns may sometimes be cut into 25 or 30 blanks; one shell is figured from which 28 20-line blanks were sawed.

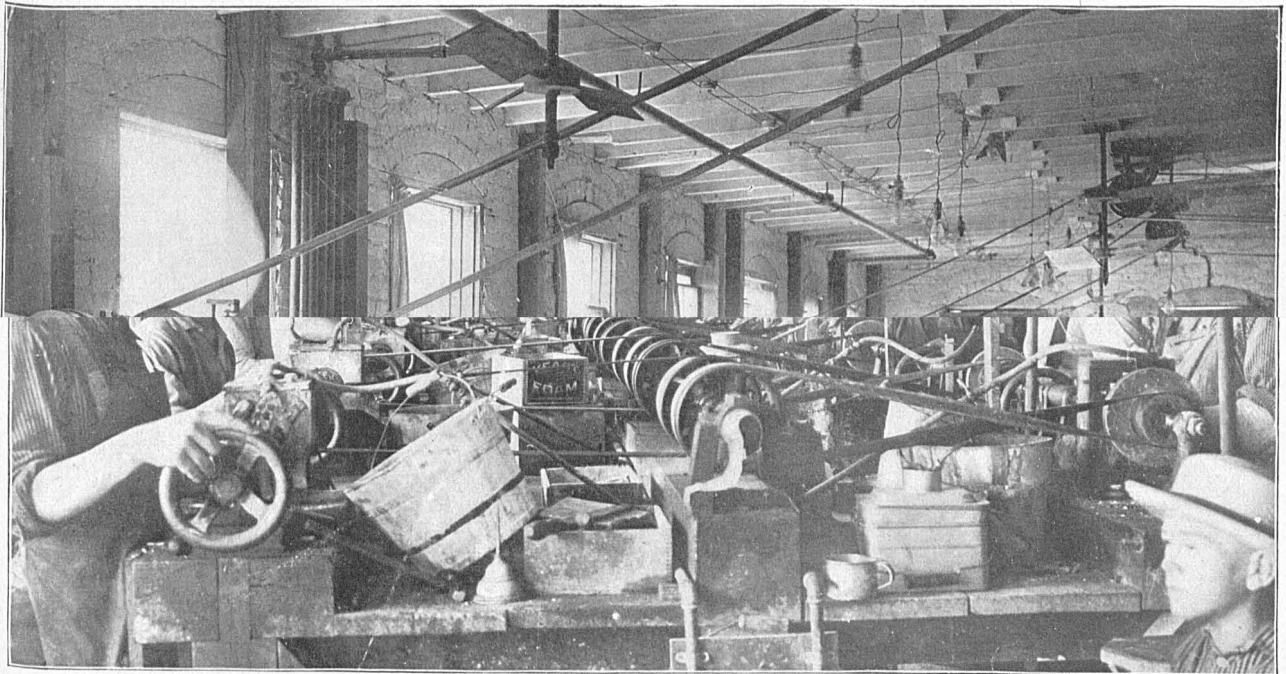
THE FACTORY HANDS AND THEIR WAGES.

At the button factories on the Mississippi River in Iowa and Illinois a large number of persons are employed at wages generally regarded as good. Besides men, who have the more arduous and important duties, many boys and girls, who would otherwise be idle, are given employment.

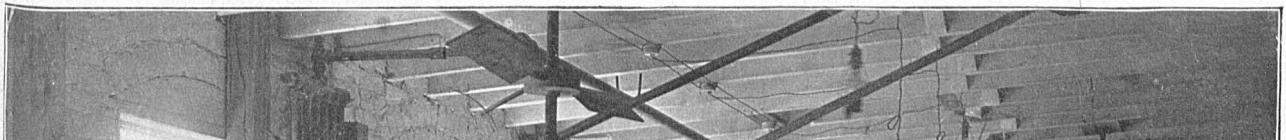
In 1897 the employees in the button factories of Muscatine numbered 532; in the first half of 1898 the number had increased to 829; at the other places embraced in this report, 282 persons were employed in 1897 and 605 in the first six months of 1898,

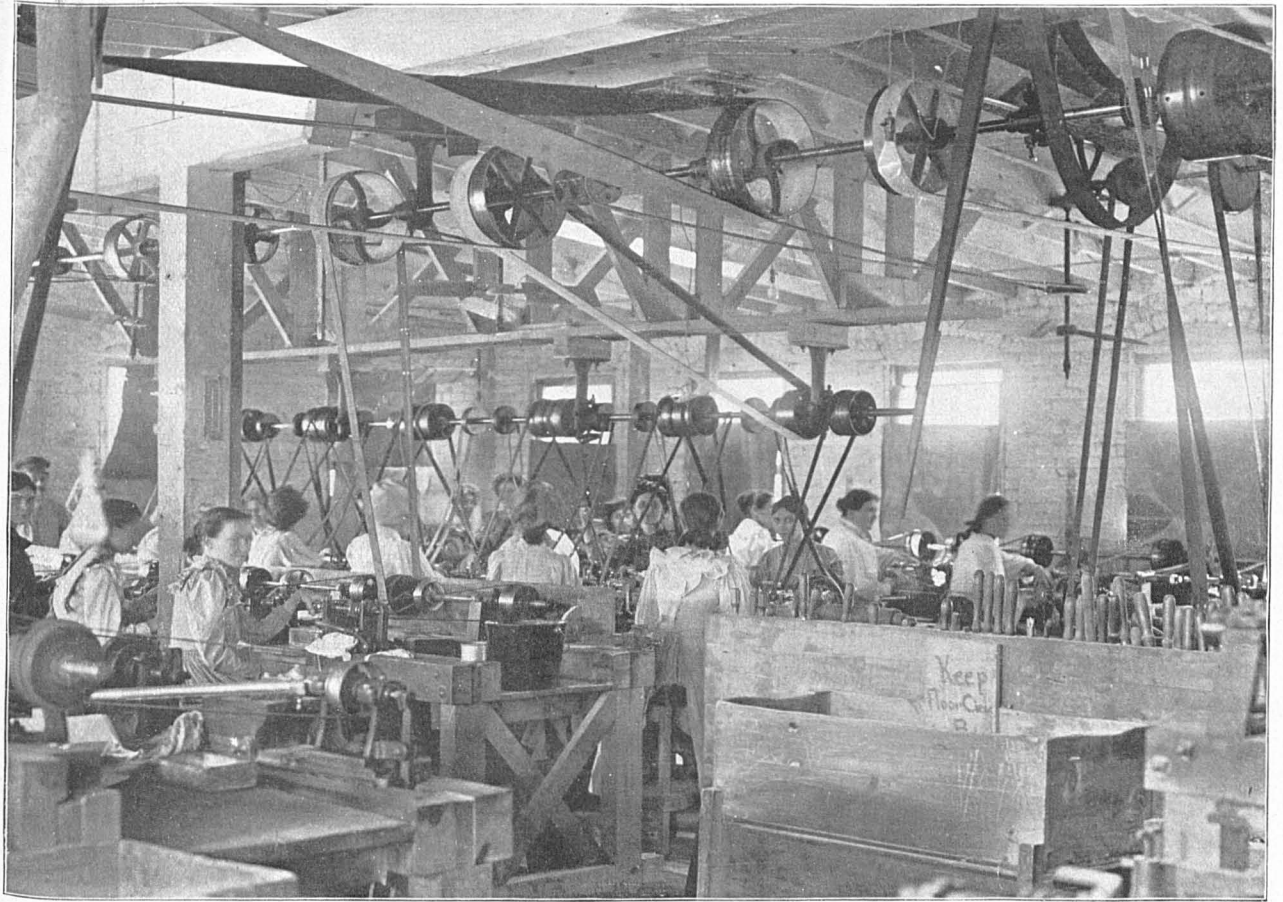


INTERIOR OF BUTTON FACTORY. Sawing the rough blanks.

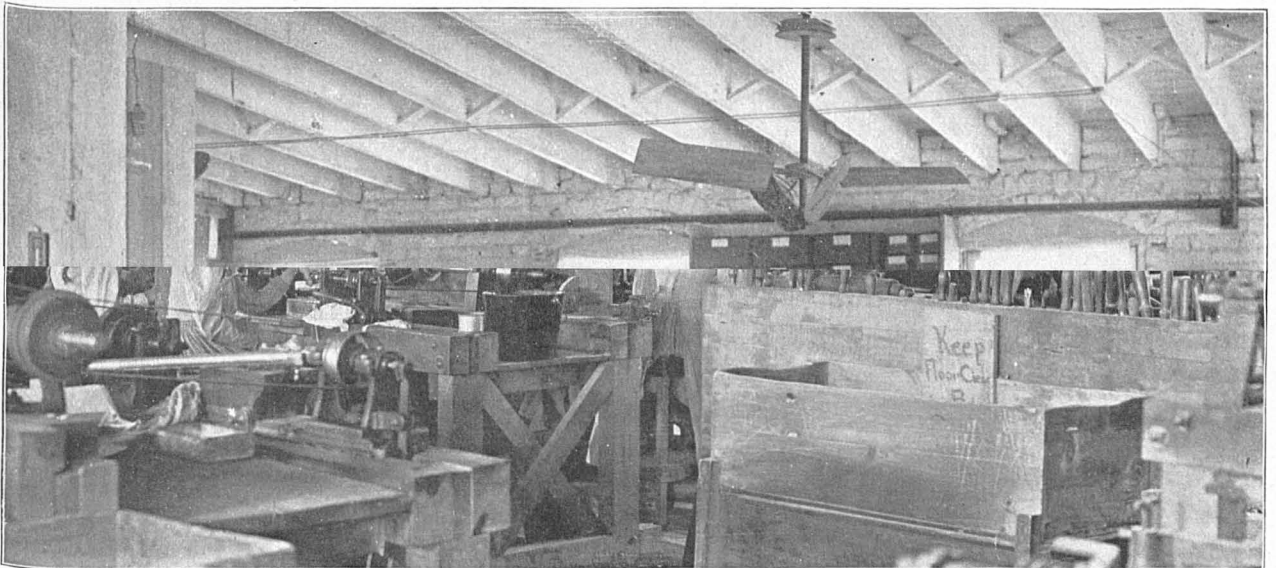


INTERIOR OF BUTTON FACTORY. Sawing the rough blanks.

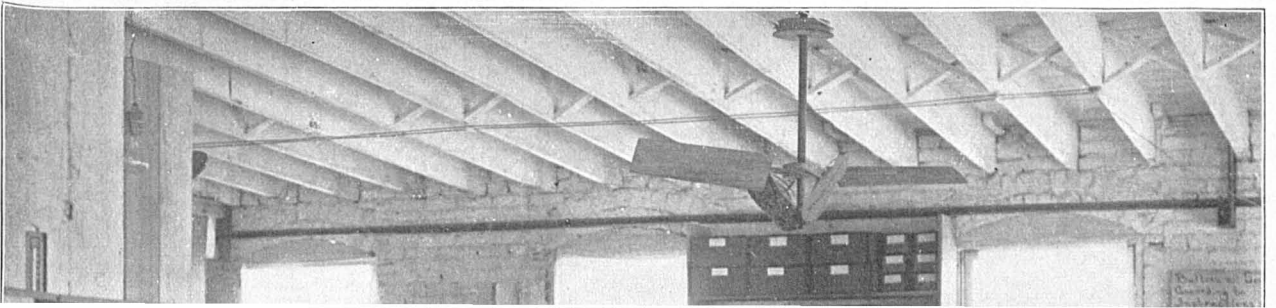




INTERIOR OF BUTTON FACTORY. Drilling holes in the buttons.



INTERIOR OF BUTTON FACTORY. Drilling holes in the buttons.



giving a total of 814 for 1897 and 1,434 for 1898. Of the latter, 1,042 were males and 392 females.

In the factories in which finished buttons are made, from 30 to upward of 200 people are employed, the males and females being in about equal numbers. The factories which simply produce the "rough blanks" employ only males, the number of whom averages only 14, and only one such factory employs more than 30 persons. This is an extensive establishment in Muscatine, having 110 hands in 1898.

Taking a large Muscatine factory as an example, the following are the various capacities in which the employees are engaged:

Nature of employment.	Number.
Cutters (all men).....	55
Dressers and grinders (boys).....	30
Facers (girls).....	30
Drillers (girls).....	32
Sorters and carders (girls).....	36
Packers, etc. (girls).....	15
General employees (men and boys).....	15
Managers and clerks.....	3
Total.....	216

The best wages are received by the cutters, who are always men. In the larger factories they are paid 5 to 10 cents a gross (14 dozen) for "rough blanks," according to size. Skilled men can cut from 150 to 200 gross of blanks per week, and can earn \$15, but the average is \$8 to \$10.

While the cutters are paid by the gross, the quantity is determined by weight, as too much time would be lost in actually counting the blanks. A scale of weights per gross for blanks of different sizes is established. Thus, 1 gross of 20-line sand-shell blanks weighs $1\frac{1}{2}$ pounds.

The pay of grinders is $1\frac{1}{2}$ to $2\frac{1}{2}$ cents a gross, or from \$5 to \$7 a week.

Dressers are paid 1 to 2 cents a gross, and make about \$4 50 a week.

Facers receive 2 to 3 cents a gross, and earn \$4 to \$6 a week. They are usually young women.

Drillers are paid $1\frac{3}{4}$ to $3\frac{1}{2}$ cents a gross, and make about \$5 a week.

Those who sort the buttons into lots homogeneous as to size and quality are paid by the day, and earn about \$3.75 a week.

The price paid for sewing the buttons on cards is 3 cents a gross. The girls who do this work make \$4 or \$5 a week.

Those who pack the carded buttons in boxes and the boxes in the shipping cases are paid \$5 a week.

PRICES AND MARKETS FOR BUTTONS.

It was very generally reported in 1898 that the button industry was being overdone by the establishment of numerous small factories at which rough blanks were sawed. Many persons engaged in the business without proper equipment or experience, and the very short life of some of the factories shows that the remarkable increase in the business in 1898 was not a healthy growth. Some of the output was not of standard quality, and a general lowering of prices has been a result.

The prices received for rough blanks in 1897 and 1898 ranged from 10 to 20 cents a gross, depending on size and quality. The prices corresponded rather closely with the sizes, an 18-line blank, for instance, bringing 18 cents a gross; but as a rule the

prices were less than the figures representing the sizes of the blanks, being 1 to 3 cents "under the line." The average size of the rough blanks was 18 or 20 lines, and the average value per gross was 16 or 18 cents.

The wholesale prices received for the finished buttons have been a little over double those of the rough blanks of the same sizes. The average prices for complete buttons in 1897 and 1898 were 35 to 40 cents a gross. The following were the ruling prices for buttons of the stated sizes and qualities during the past year as furnished by one of the leading firms:

First grade.		Second grade.		Third grade.	
Size.	Per gross.	Size.	Per gross.	Size.	Per gross.
	<i>Cents.</i>		<i>Cents.</i>		<i>Cents.</i>
16-line	55	16-line	50	16-line.....	40
18-line	60	18-line	55	18-line.....	45
20-line	65	20-line	60	20-line.....	50
22-line	70	22-line	65	22-line.....	55
24-line	75	24-line	70	24-line.....	60

In addition to the foregoing, a superfine button is manufactured which sells for about 15 cents per gross more than the first grade, and a cheap button, used chiefly by shirt-makers, which brings from 25 to 30 cents a gross.

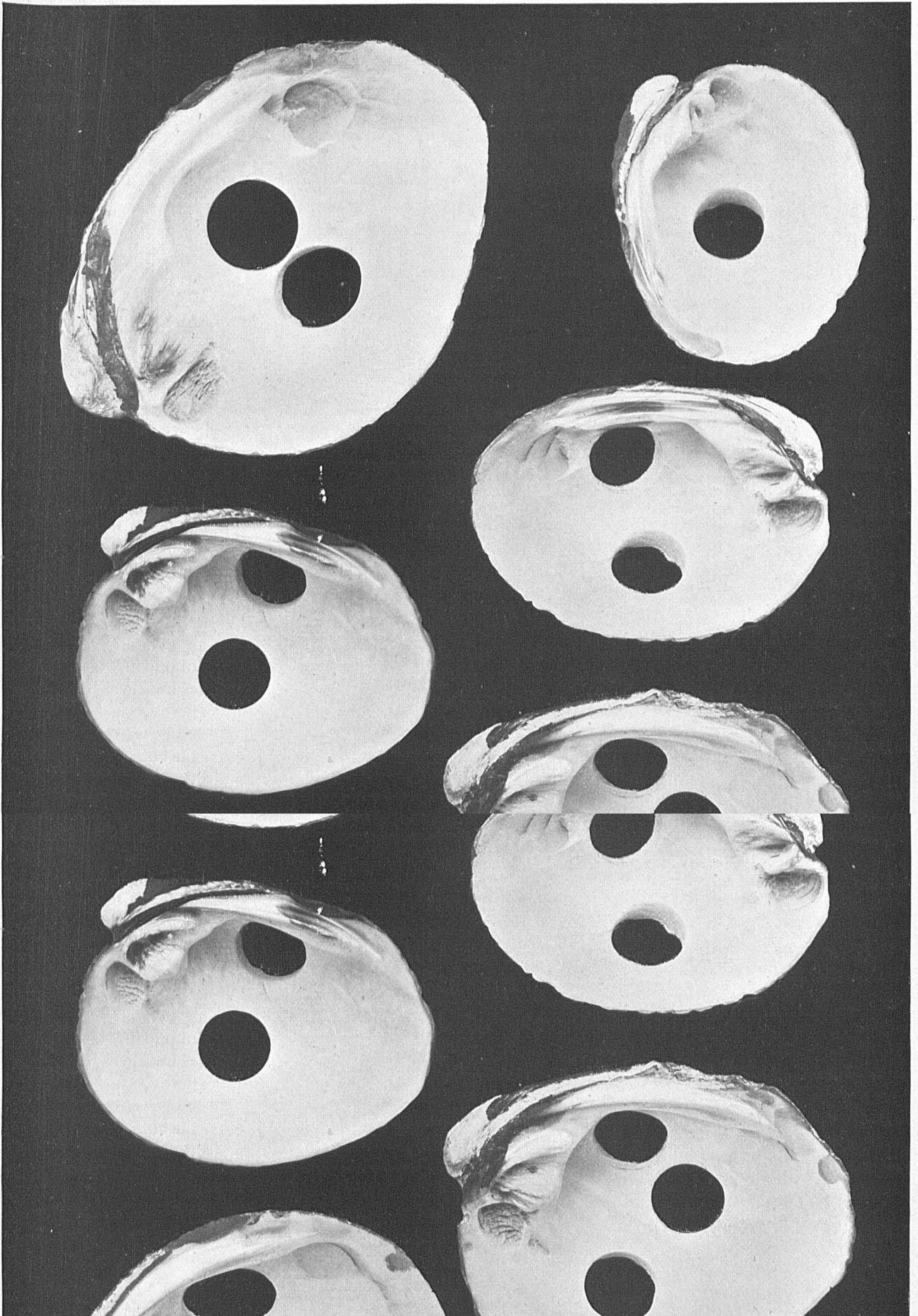
There was naturally some difficulty at first in putting on the market buttons made from our native fresh-water shells, but the demand was rapidly developed, as the quality and price of the buttons became known, and at present Mississippi River buttons are sold in every State and Territory and in Canada. It is reported that orders have recently (1899) come from England.

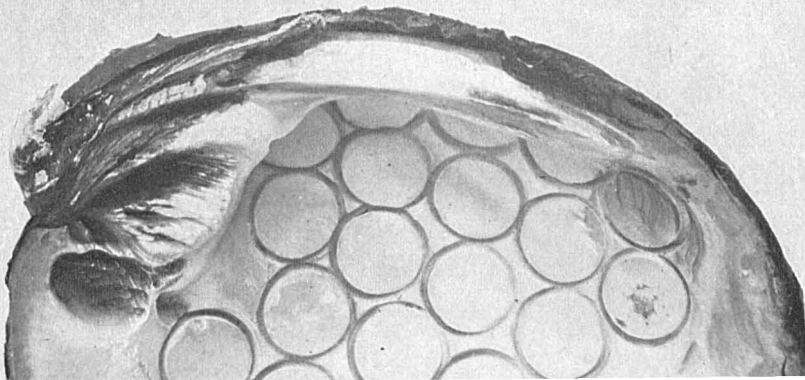
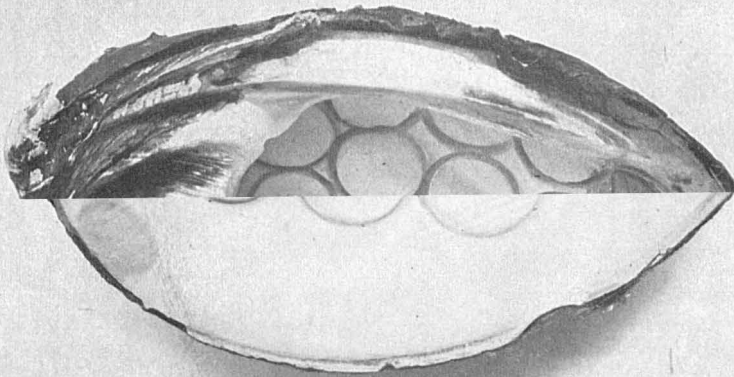
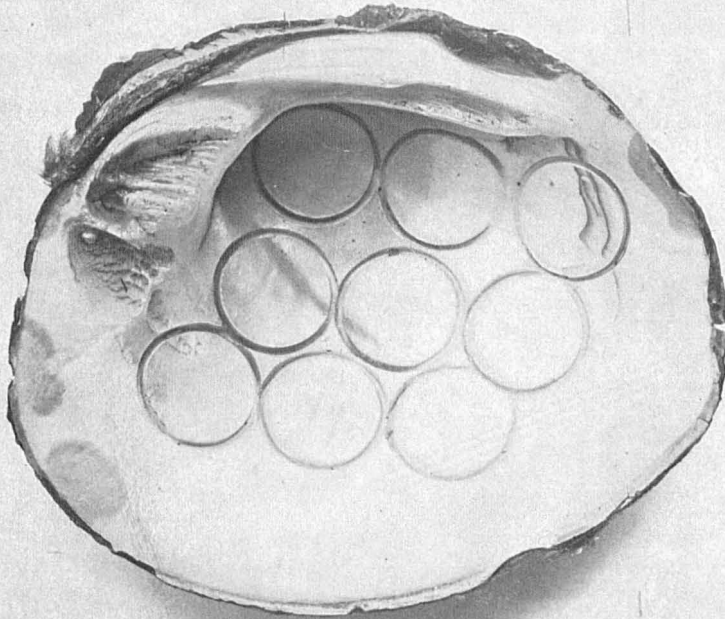
UTILIZATION OF WASTE.

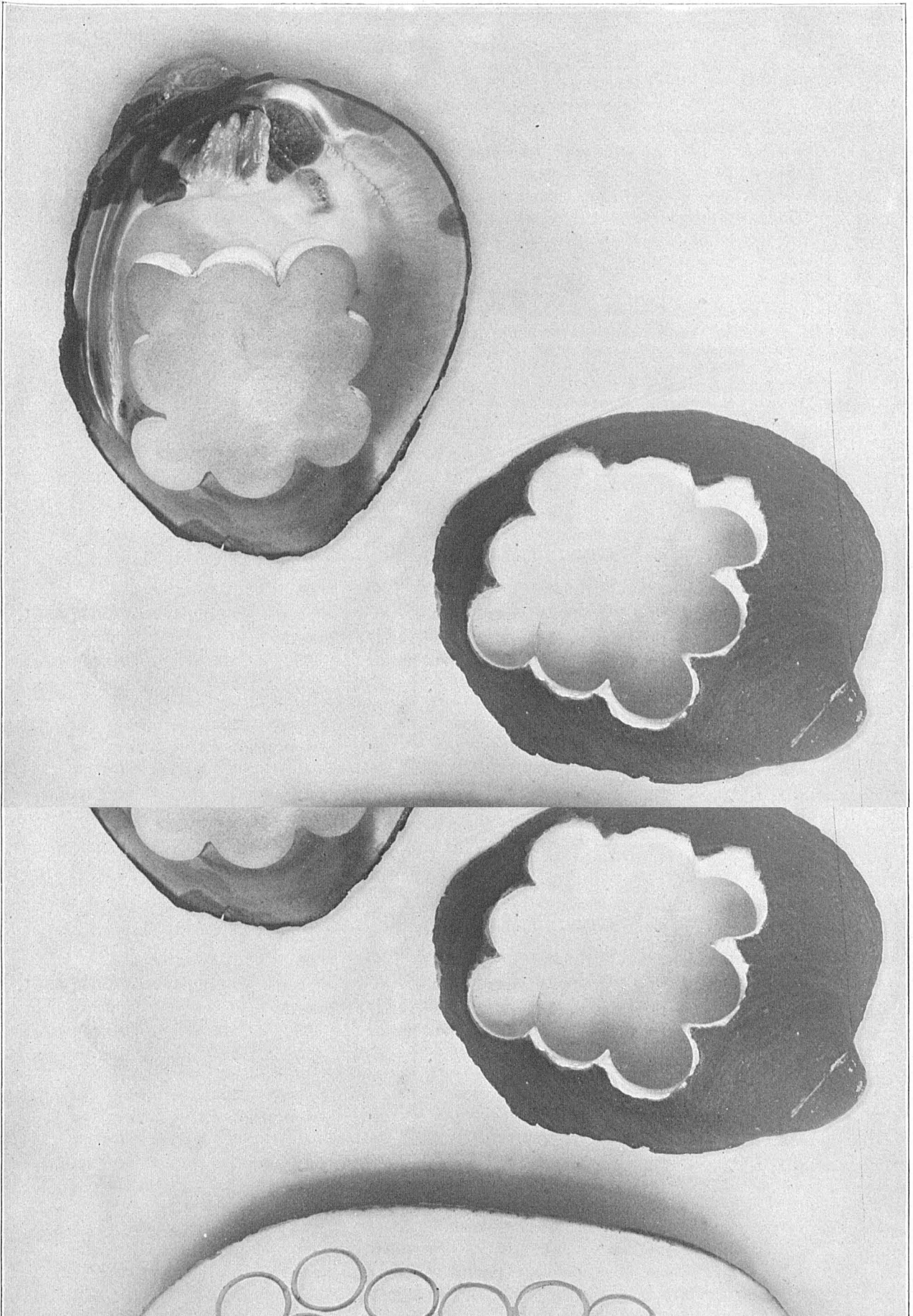
In sawing the blanks a large part of the shell can not be used, as it is incapable of being made into merchantable buttons. The relatively thin margin of the valves and the thick beak or umbo furnish the principal waste. The amount of unserviceable raw material is extraordinarily large, although it varies with the different species and to some extent with the different factories. In the aggregate it probably represents over 75 per cent of the weight of shells handled, and, according to the testimony of the manufacturers, with the principal mussel employed, the "niggerhead," from 85 to 93 per cent, by weight, is discarded in sawing blanks, the average loss of material being about 90 per cent. In facing, grinding, drilling, and polishing the blanks, and in defective blanks, there is a further waste, estimated at 20 to 50 per cent of the original weight of the blanks. With "sand shells," "deerhorns," and some other species, the waste is much less, amounting to probably only 50 per cent, all told.

As the accumulation of waste soon proves a nuisance, the factory owners are naturally desirous of finding some uses to which it can be put. If a market could be found for it, even at a very low price, it would be a decided boon to the industry. Many of the manufacturers feel that it has a value, but they have not been able to discover a way in which to dispose of it for any financial consideration, and practically the only use to which it has been put has been in making roads, the municipal authorities hauling it from the factories. As a rule, the manufacturers are glad to get rid of it in this way, and some of them have even paid to have it taken away.

Farmers occasionally call for small quantities of finely broken shells for use as food for chickens and turkeys, but the demand is very limited. In the opinion of the United States Department of Agriculture, the value of the shells for such a purpose is







considerable, and at least one factory has introduced a special machine for reducing the shells to small fragments of uniform size, with rounded edges.

In sawing, grinding, and drilling the blanks, a fine white powder results. Much of this has been saved by the button manufacturers in the hope that some use may be found for it. Small quantities have from time to time been given to farmers to experiment with as a fertilizer, but no demand for it has been created, and its value in this respect has only been conjectural. In order to obtain an authoritative opinion as to the feasibility of employing this powder as a fertilizer, the U. S. Commissioner of Fish and Fisheries submitted a sample to the Secretary of Agriculture, who reported as follows:

The fine-ground powder, which is the refuse of the pearl-button industry, transmitted to me in connection with your letter, has been examined by the chemist of the Department and found to be almost pure carbonate of lime. It will prove a valuable fertilizing material for stiff clay soils and for other soils deficient in lime. In the fine state of subdivision in which it exists, it could be applied directly to the soil without further preparation. I should advise persons engaging in this industry to communicate with the directors of the agricultural experiment stations of their respective States in regard to the utilization of this waste material for fertilizing purposes.

This powder without further preparation is undoubtedly excellent for polishing coarse metalware, and, if screened to remove any larger particles, might even be used for cleaning and polishing silverware, cutlery, etc.

The use of the powder in stucco-work has also been suggested.

AVOIDABLE WASTE OF RAW MATERIAL.

Although, under the most favorable circumstances, there is a very large loss of material that can not be avoided, at the same time there is a certain amount of preventable waste that in the aggregate must represent many thousand gross of buttons annually. This waste consists in the failure of the sawers to utilize all the available shell, and naturally varies greatly with different men and different factories.

The accompanying illustrations of shells that were picked almost at random from the discarded heaps of certain Muscatine factories clearly indicate, even to a person not versed in the button business, the unnecessary waste of material, and render scarcely needful the presentation of contrast illustrations, showing the buttons that may be cut from such shells.

From the waste heap of one manufacturer 13 "niggerhead" shells were picked at random; from these 26 rough blanks had been cut, of which 19 were capable of being made into salable buttons. The same shells were taken to another factory where 48 additional good blanks were cut. Here was an avoidable loss of 65 per cent.

Another example of waste, and probably an extreme one, was recorded in a Muscatine paper in August, 1898: A button manufacturer picked up 16 shells from a pile that was being spread on a road. From these 31 blanks had been cut. He took the discarded shells to his factory and sawed out 152 merchantable blanks. In other words, 83 per cent of the raw material had been wasted.

It is not to be supposed that the manufacturers sanction the waste of material in cutting blanks. The trouble is that the cutters are often careless or inexperienced, and can not always be kept under the supervision of the foreman or manager. As the cutters are paid for the blanks they cut, it is decidedly to their personal advantage to get as many blanks as possible out of each shell they handle, as there is loss of time in throwing one shell away, taking a new one, and fitting it to the saw.

STATISTICS OF THE BUTTON INDUSTRY.

In the following series of tables the extent of the button industry of the Mississippi River is shown for the calendar year 1897 and the first six months of 1898. At the time of the investigation the season was not over and no complete statistics for 1898 could be obtained. It should therefore be borne in mind that the figures given for that year represent less than half the extent of the business, as a number of new factories were established after July 1.

Outside of Muscatine, there are only from one to three factories in any one place; and in order that private interests may not be disclosed, the statistics for all the factories in each State are combined.

The 814 persons employed in 1897 are shown to have received \$157,650 in wages, while the 1,434 employed in the first half of 1898 were paid \$133,980.

The capital invested in the button-manufacturing business, in buildings, machinery, equipment, and land, was \$118,300 the first year and \$171,435 the second.

The cost of raw materials used in button-making was \$40,408 in 1897 and \$37,008 in 1898, these amounts representing 3,602 tons and 3,641 tons, respectively.

The manufactured products consisted of 463,200 gross of buttons and 673,200 gross of blanks in 1897 and 399,489 gross of buttons and 761,113 gross of blanks in 1898. The market value of the buttons and blanks was \$243,655 in 1897 and \$252,570 in 1898.

Persons employed and wages paid in the button industry of the Mississippi River in 1897 and 1898

Localities.	Male.		Female.		Total.		Wages.	
	1897.	1898.	1897.	1898.	1897.	1898.	1897.	1898.
Muscatine, Iowa.....	334	590	198	239	532	829	\$120,100	\$87,800
Other places in Iowa ..	87	168	62	123	149	291	11,800	23,190
Places in Illinois	105	284	28	30	133	314	25,750	22,000
Total	526	1,042	288	392	814	1,434	157,650	133,980

Capital invested in the button industry of Iowa and Illinois in 1897 and 1898.

Localities.	1897.	1898.
Muscatine, Iowa.....	\$77,300	\$98,705
Other places in Iowa	23,000	34,000
Places in Illinois	18,000	38,730
Total	118,300	171,435

Quantities and values of mussel shells used in the button industry of the Mississippi River in 1897 and 1898.

Localities where used.	Niggerheads.		Sand shells.		Muckets.		All others.		Total.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1897.										
Muscatine, Iowa.....	2,309.00	\$24,184	104.00	\$5,410	31.75	\$187	17.25	\$502	2,522.00	\$30,283
Other places in Iowa	450.00	3,675	.....	.....	.....	.....	.....	.....	450.00	3,675
Places in Illinois	525.00	5,250	50.00	1,000	50.00	100	5.00	100	630.00	6,450
Total	3,284.00	33,109	214.00	6,410	81.75	287	22.25	002	3,002.00	40,408
1898.										
Muscatine, Iowa.....	2,216.00	24,175	20.00	547	26.25	154	10.39	149	2,273.24	25,025
Other places in Iowa	741.00	5,865	2.50	15	.....	.....	.50	2	744.00	5,882
Places in Illinois	572.00	5,591	50.00	500	.....	.....	2.00	10	624.00	6,101
Total	3,529.00	35,631	73.10	1,062	26.25	154	12.89	161	3,641.24	37,008

Quantities and values of finished buttons and rough blanks made in the button factories on the Mississippi River in 1897 and 1898.

Years and localities.	Finished buttons.		Rough blanks.		Total buttons and blanks	
	No. of gross.	Value.	No. of gross.	Value.	No. of gross.	Value.
1897.						
Muscataine, Iowa.....	313, 200	\$109, 270	418, 200	\$60, 385	731, 400	\$175, 655
Other places in Iowa.....	110, 000	33, 000	.....	.....	110, 000	33, 000
Places in Illinois.....	40, 000	10, 000	255, 000	25, 000	295, 000	35, 000
Total.....	463, 200	152, 270	673, 200	91, 385	1, 136, 400	243, 655
1898.						
Muscataine, Iowa.....	177, 696	66, 554	541, 120	84, 331	718, 816	150, 885
Other places in Iowa.....	195, 793	66, 787	48, 000	6, 040	243, 793	72, 807
Places in Illinois.....	26, 000	8, 000	171, 993	20, 878	197, 993	28, 878
Total.....	399, 489	141, 321	761, 113	111, 249	1, 160, 602	252, 570

RECOMMENDATIONS.

In view of the very general desire of those pecuniarily interested in this industry that some recommendations be made by the U. S. Fish Commission regarding the measures that seem necessary for preventing the further depletion of the mussel beds and the consequent curtailment of all branches of the business, the following suggestions are submitted. It should, however, be understood that the perpetuation of this important industry depends wholly on the joint action of the States concerned, and that the General Government and the U. S. Fish Commission are entirely without jurisdiction. The measures here advocated will, it is thought, be generally indorsed by the button-makers, a large majority of whom have been consulted regarding this matter; they should also commend themselves to the fishermen, who are vitally interested in having the mussel supply maintained.

1. *The gathering of small mussels should be prohibited, and a minimum legal size for each important species should be prescribed by law.*

The following are the minimum sizes of the principal shells that should be gathered, the figures referring to the greatest diameter: Niggerheads, 2½ inches; sand shells, 4 inches; muckets, 4 inches.

A niggerhead 2½ inches long will yield from 8 to 10 buttons 18 to 20 lines wide. A sand shell 4 inches long contains from 8 to 12 buttons of the same size, and a mucket about the same number.

2. *Immediately prior to and during their spawning season the principal species should be unmolested, and a close season should be fixed by law.*

The question of a close season presents some difficulties in view of the widely different spawning times of the various species of mussels. Probably the only species that need to be considered at this time are the "niggerhead," the "mucket," and the "sand shell." The normal spawning time of the "niggerhead" in the central part of the Mississippi Basin is late winter and early spring, chiefly the months of February, March, and April, while the spawning time of the "mucket" and "sand shell" is the summer and early fall.

The "niggerhead" is so much more important than all of the other species combined that protective legislation addressed to it alone would prove perhaps sufficient,

in view of the desirability of reducing the fishing season as little as practicable. The measure, therefore, which would probably accomplish the most good would be the establishment of a close time for "niggerheads" from January 1, or the time of ice formation in the Mississippi, to May 1.

3. *Provision should be made for the prevention of damage to the beds by sewage and factory refuse.*

The damage to the mussel beds in the Mississippi River in Iowa and Illinois by river pollution is to a large extent prospective, but adequate steps should be promptly taken to obviate this source of injury. The effect on animal life—especially that on the bottom—of the discharge of city and factory refuse into streams has hardly been considered by those interested in the preservation of the mussels, but it constitutes, perhaps, the most serious menace to the industry, in that the destruction wrought is inevitable and complete. Mr. Simpson thus refers to the injury to mussels which is caused by antiquated methods of disposing of refuse:

The dumpings of manufactories and the sewage of cities turned into rivers is destroying not only the fish but the *Naiades*. In many places below factories or cities the water of the streams is offensively foul and wholly changed in color, so that practically no kind of organic life can exist in it. Along the Potomac and Shenandoah rivers, in the vicinity of Harpers Ferry and above it, are a number of mills which grind wood into a pulp for the manufacture of paper. These throw their sawdust and waste into the streams, and down below, where the water is comparatively quiet, it settles to the bottom, forming great masses of slushy, putrid matter, which is, no doubt, destructive to fish and unios. The city of Chicago is about to turn its sewage into the Des Plaines River, from which it will be carried into the Illinois River, a stream abounding with the very finest fresh-water mussels. There can be but little doubt that this great volume of filth and poison will destroy every *Naiad* in both of these streams, and possibly it may exert its deleterious influence even on the Mississippi River also.

4. *In order that local industries may be fostered and the catch of mussels made no larger than can be utilized by the factories in the vicinity, the matter of prohibiting the shipment of shells to distant States should be considered.*

There is little doubt that the button factories now in operation in Iowa and Illinois can more than consume all the mussels that should be gathered from the section of the river under discussion. It is held by some persons having pecuniary interests at stake that the raw materials should be reserved for those who have invested their capital in permanent improvements and have established local industries, and that the continuance of the business should not be endangered by unrestricted shipment of shells to distant States and countries.

5. *Button manufacturers should exercise greater care in utilizing their shells in order to reduce the waste of raw material.*

This subject has already been sufficiently discussed.

