

In law enforcement work the plane is one of the most important pieces of equipment you can purchase today, not so much from the standpoint of arrests but the psychological effect of any aircraft in an area will make a violator stop to think, "Is that the Game & Fish plane flying around up there?" It would be hard to estimate in dollars and cents the value of the aircraft in our work.

THE ILLINOIS MUSSEL

BY AL C. LOPINOT
Chief Fishery Biologist
Illinois Department of Conservation

At the turn of the century when mussel shells were raw material for pearl buttons, fishing for freshwater mussels in Illinois was a big business. After World War II the pearl button was replaced by plastic, and mussel fishing declined.

Once again, however, fleets of boats dredge the river bottoms for mussel shells because Japan is using the shells for producing cultured pearls. This is the story of mussel fishing and its relation to cultured pearls.

THE FRESHWATER MUSSEL

Freshwater mussels or clams live in the bottom muds or in sand and gravel bars of most streams and lakes. The mussel's soft body is enclosed in a hard hinged shell which opens to let the animal eat, breathe, and reproduce and which shuts for protection. The mussel moves by expanding and contracting a fleshy foot that is extended through the lower part of the shell and is attached to the bottom material of the stream. Two siphons are extended from the top portion of the shell; one takes in water, the other expels water and waste products. The incoming water passes over the gills and mouth to supply oxygen and food.

The "mantle," a tissue covering the body of the mussel, produces a substance called *nacre* or "mother-of-pearl" which makes up the hard shell. The shells grow larger and thicker each year—the rate of growth depends upon the food supply and species of mussel.

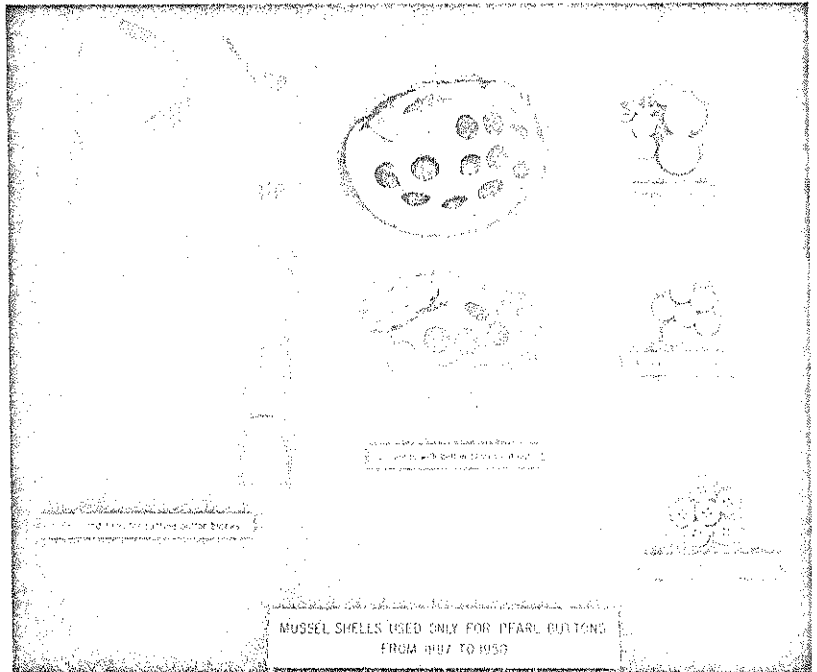
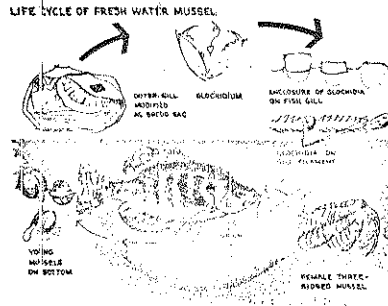
During the breeding season the male mussel discharges sperm into the water through its excurrent siphon, and the female produces eggs which become attached to her gills. Water containing the sperm enters the female through her incurrent siphon and passes over the gills. The fertilized eggs develop on the gills for a period of time and are then shed into the water as minute larvae called glochidia. The glochidia usually attach themselves to the gill of certain species of fish, and there they live for several weeks as parasites. After the glochidia develop, they break loose and fall to the bottom of the stream as tiny mussels to live, feed, and grow to maturity.

There are over fifty major species of freshwater mussels living in our Illinois waters. About a dozen of the thicker shelled ones are of commercial value.

PEARL BUTTONS

In the early 1900's thousands of mussel boats plied the Illinois rivers in search of mussel shells and freshwater pearls. The shells were used in the manufacture of pearl buttons, and the waste portion of the shell was used for poultry grit. Button manufacturing from freshwater mussel shells originated in Europe in 1840. In 1892 the first pearl button factory was established in the United States, at Muscatine, Iowa, by J. F. Boepple, a German immigrant. Muscatine became known as the pearl button capital of the world. Most of the

LIFE CYCLE of freshwater mussel includes short stage as parasite on fish gill.



PEARL BUTTON industry once stimulated mussel fishing along the Mississippi and Illinois Rivers, but introduction of plastic buttons brought fishing to a standstill after World War II.

shells caught by Illinois fishermen were sold in Muscatine. In the manufacture of buttons the button blanks were first cut from the shell with a cylindrical saw. The blanks were ground to desired thickness, placed in automatic machines for the facing and drilling of holes, then polished in tumblers. Next they were graded and sorted according to size and design. Some were dyed while others were left with their natural pearl color.

During the peak years Illinois mussel fishermen produced from one to four thousand tons of shells annually for pearl button manufacture; they received an average of about fifteen dollars per ton. After plastics were introduced, the demand for shells decreased. Mussel fishing

came to almost a standstill after World War I. In the early days freshwater pearls were a frequent prize for the mussel fisherman, and some sold for over two thousand dollars.

MUSSEL FISHING

Mussel fishing has changed very little since the turn of the century. The most popular method continues to be the use of the crowfoot bar. Mr. and Mrs. Elmer Dill of Mt. Carmel are experts in this method of fishing. Elmer makes his own wooden flatbottom boats, designed to carry and pull bars over the mussel beds. The crowfoot bar, or brail, consists of either an iron pipe or a 2 x 4 piece of lumber about fourteen to sixteen feet in length. Gangs of crowfoot hooks are attached to the bar about four inches apart along its entire length. The crowfoot is a special handmade hook with four prongs bound together by a wire spiral or by a twist. Three or four of these hooks are attached to the bar in a gang by wire, chain, or twine. Some fishermen prefer six or more hooks in a cluster attached to the end of a small length of chain. Two crowfoot bars are worked on each boat, and a bridle rope for towing is attached near both ends and in the center of the bar. Two upright notched standards on each side of the boat hold the bars when they are not in the water.

The fisherman uses a "mule" as an underwater sail to pull his boat and bar over the mussel bed. This mule consists of a frame with heavy canvas or a large plywood board nailed to it. Guide ropes are fastened to the mule in order to control its pulling power in the water.

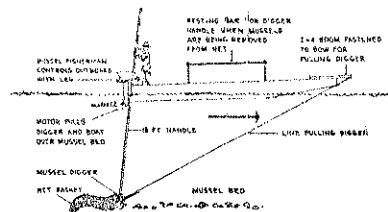
The crowfoot bar is placed in the water from the bow of the boat with the bridle rope attached to a special holding device on the bow. The mule is dropped into the water from the stern. When the current strikes the broad surface of the mule, the boat and crowfoot bar are pulled over the bed. Mussels lie in the sand or mud facing upstream with their shells partially open. As soon as a hook touches the body of one of them, the mussel closes its shell on the hook. After combing the mussel bed, the bar is raised and placed on the standards, and the shells are removed. The desirable shells are thrown into the bottom of the boat, and the undesirable ones are put back into the water. The fisherman then raises the mule and heads upstream to begin another drift over the bed.

Elmer Dill's fishing day begins at dawn when he cruises the Wabash to a mussel bed which he had found previously. Other fishermen may be on the same bed, but usually a bed is several hundred yards or several miles long, big enough to accommodate more than one boat. As the mule pulls the boat downstream, Elmer repairs the crowfoot hooks that have been damaged on a previous run. He fishes the bed all day and may harvest from a few pounds to perhaps a ton of shells. At the end of the day he returns to shore, sacks up the shells, and takes them home.

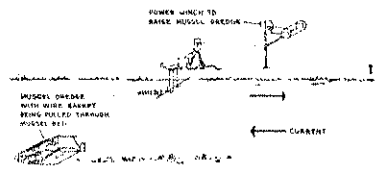
The next morning, while Elmer drifts over the mussel beds, Mrs. Dill "cooks out" the shells. Water is poured into a large metal vat, the shells are dumped into it, and it is covered with burlap. A fire is kindled under the vat, and the water boils and steams open the shells. After about twenty minutes the shells are cooked enough for removal of the mussel meat.

The cooked shells are placed on a sorting table, and Mrs. Dill and her family remove the mussel meat and sort the shells by species. They search the meats for valuable pearls, pearl baroques, pearl slugs, rose bud pearls, turtle back pearls, pearl spikes, and button pearls. The mussel meat is stored in containers, left to ferment, and later is sold as catfish bait to commercial fishermen.

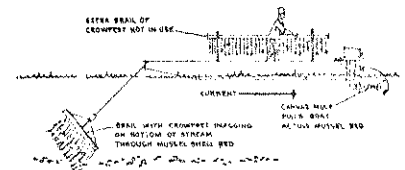
Because the Dills are also buyers, they will cook out shells for other fishermen or buy cleaned shells. The price varies depending upon the kind, size, and thickness of the shell. The maple-leaf-mix-variety, which include the monkey face, warty and pimple back, pig toe, maple leaf, and niggerhead shells brought as much as five hundred dollars per ton



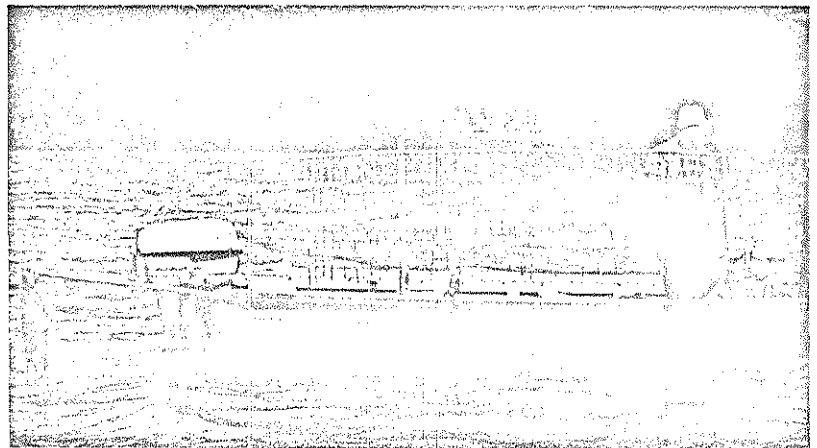
SIDE VIEW OF HAND-OPERATED MUSSEL DIGGER (RAKE OR DREDGE) IN OPERATION



SIDE VIEW OF POWER OPERATED MUSSEL DREDGE IN OPERATION



SIDE VIEW OF MUSSEL FISHING BOAT IN OPERATION USING CROWFOOT BARS



MUSSEL FISHERMAN repairs crowfeet hooks and straightens lines while fishing along the Wabash. Note "mule," attached to stern of boat, which acts as underwater sail.

paid in 1966. The washboard and buckhorn shells brought a lower price with a maximum of about one hundred dollars per ton paid in 1966. The three-ridge shell brought about three hundred dollars per ton. These are the principal shells of commercial value at the present time.

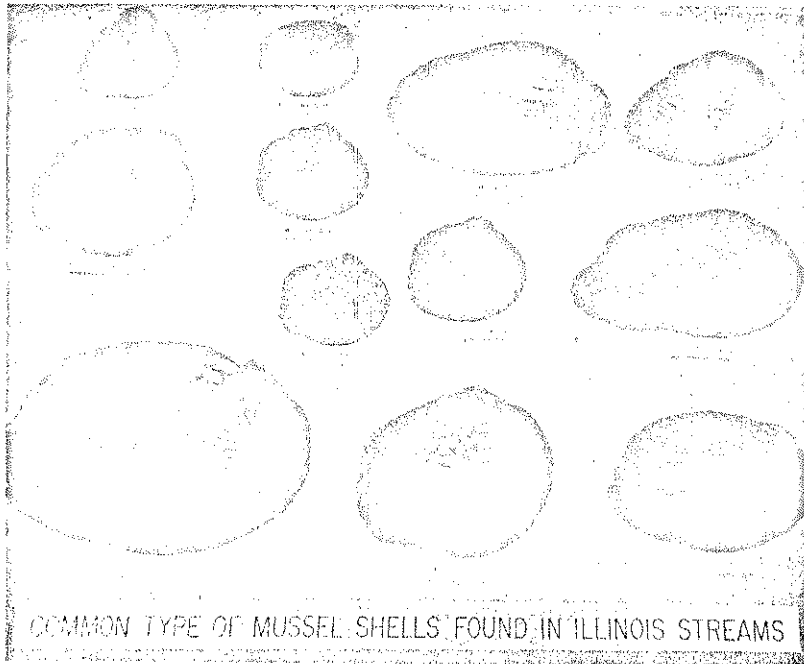
Elmer Dill has his shells sorted into bins. When he has accumulated a large supply, he contacts an exporter who picks them up and transports them to his place of business. The exporter then grades the shells for size and kinds, sacks them in two hundred pound bags, and trucks them to New Orleans where they are placed aboard Japanese ships for shipment to Japan.

In midsummer, when the water levels on the Wabash are too low for the use of the crowfoot bar, fishermen wade the shallows and hand-pick the mussels. Diving suits are often used to hand-pick the deep water areas.

Shellers on the Mississippi and Illinois rivers use larger boats and longer and heavier crowfoot bars than the Wabash fishermen. Sometimes two bars are dragged over the mussel beds by an outboard motor rather than by a mule. Because the water is usually deep, power

winchies are often used to pull the bars to the surface, and some fishermen put wheels on their bars to keep them off the bottom while fishing.

These big river fishermen employ a hand dredge (digger or rake) which was first used on Peoria Lake in 1911. This is a flat, triangular steel hoop on a sixteen to twenty foot wooden handle. The bottom edge of the frame has pointed steel teeth. A long two-inch mesh net bag trails from the rear of the hoop. The dredge is set on the bottom of the stream directly behind the stern. As the boat moves upstream over the mussel bed, the fisherman maintains steady pressure on the dredge so that it will stay on the bottom and scoop up everything in its path. A rope attached to the bow of the boat by a boom pulls the dredge with the boat. The lone fisherman may attach the outboard



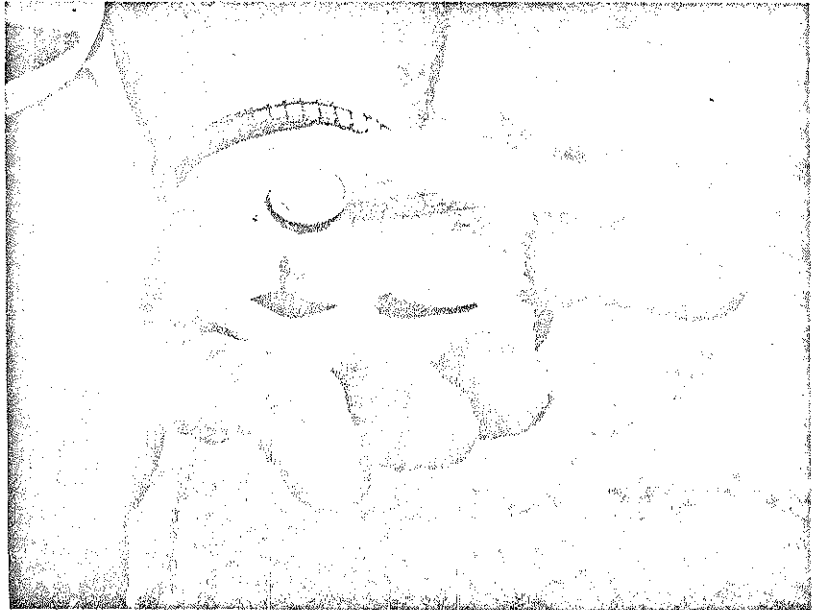
FIFTY MAJOR species of freshwater mussels live in Illinois waters but only about a dozen are of commercial value.

motor handle to his leg while operating the dredge so that he can control the boat's direction. When a run has been made over a mussel bed, the boat is turned to help bring the dredge to the surface with its catch.

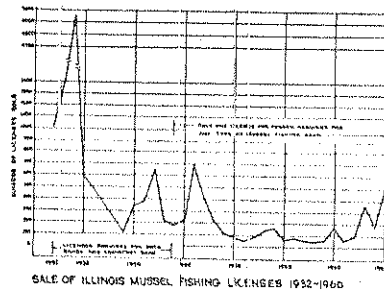
A larger version of the dredge with a steel frame and wire netting is dragged over the bed by an outboard motor and is pulled to the surface by a power winch. Some fishermen have tried power-driven dredges with conveyor belts and suction devices to harvest shells. Usually these types of rigs are too expensive to warrant their use.

Most Illinois and Mississippi River fishermen do not process their own shells, but sell them alive to a buyer who uses mechanically driven meat sorters in which the cooked shells are placed in a perforated revolving drum to separate the meat from the shells. As the shells tumble in the drum, the meats fall through the holes, and the shells spill onto a conveyor belt.

In 1965 three rivers—the Wabash, Illinois, and Mississippi—produced 2,259 tons of shells. The Wabash produced the most valuable



VALUABLE FRESHWATER pearls taken from a mussel shell. Note comparison with dime.



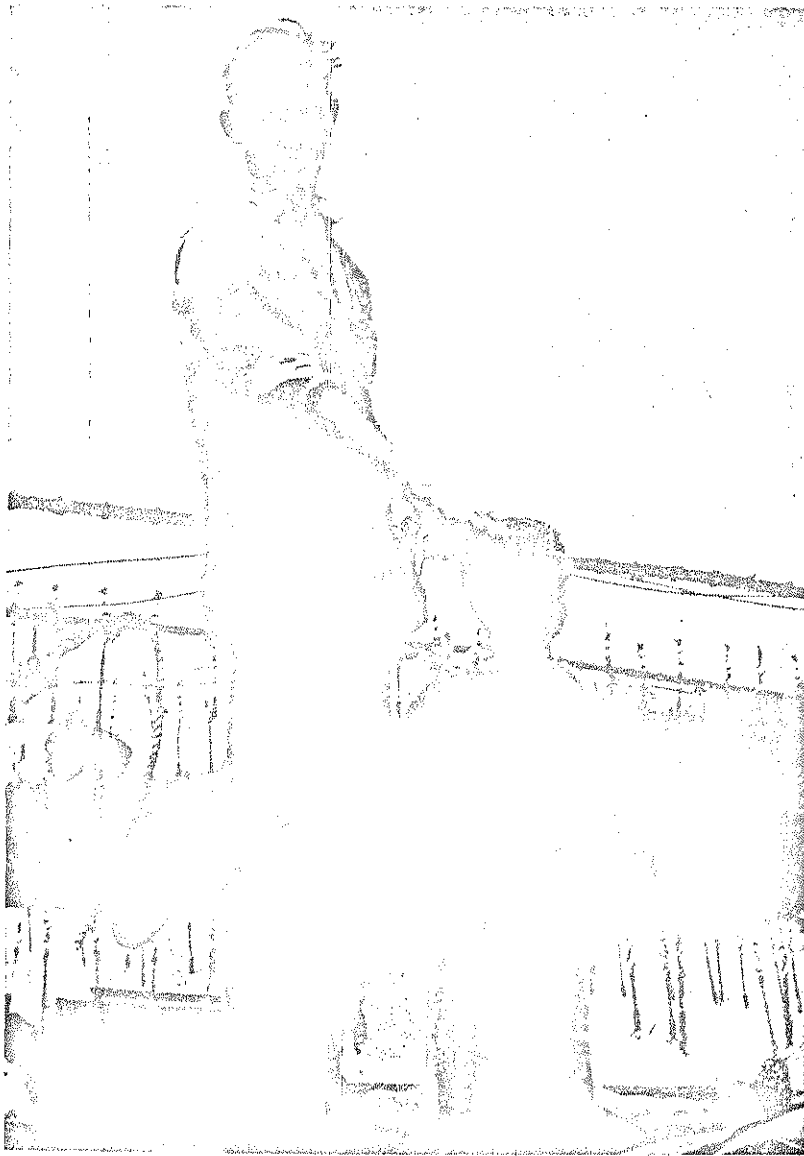
shells with 919 tons valued at \$240,000; the Illinois, 1,159 tons valued at \$75,335; the Mississippi, 181 tons valued at \$11,765.

Mussel fishing has been revived in Illinois during the last four years. After World War II the big harvest for the cultured pearl industry was in the Tennessee Valley river system but, due to over-fishing, the industry moved north.

THE ADVENTURE OF THE CULTURED PEARL

Kokichi Mikimoto of Japan developed and obtained a patent on artificial pearl culture in 1912. He experimented with many types of material to produce cultured pearls but found that the freshwater mussel shell produced the best kernel (nucleus) for high quality culture pearls. These were best because the *nacre* (mother-of-pearl) from the oyster adhered to this nucleus better than any other material. Since his discovery Japan has been the leading country in producing cultured pearls.

When Illinois mussel shells arrive in Japan, they are sent to factories where the thickest portion of the shell is cut into strips; these



ELMER DILL and son, with catch of mussels from the Wabash River. Dill, of Mt. Carmel, begins day at dawn and fishes all day and may harvest from a few pounds to a ton of shells.

strips, into cubes. The cubes are converted to round pellets by using grinding stones and a sand slurry. The pellets are polished with jewelers rouge in special rotating polishing plates and tumblers. The finished pellets are examined for imperfections, and the perfect pellets are then sold to pearl farmers. The size of the pellet will determine the size of the pearl produced. A ton of shells will produce forty to sixty pounds of pellets that can be used in the pearl industry. Most of the persons working in the pellet factories are women.

PEARL FARMING

There are about five thousand pearl farmers located in southern Japan where the Japanese pearl oyster is found.

The pearl farmer obtains his oysters by sending girl divers to collect three-year-old oysters, or he may use special cages or straw ropes suspended from rafts to capture the "spat" (larval oysters). The spat are placed in rearing cages until they are one year old, and then the oysters are placed in shallow water over rough bottoms to grow for two more years. During the third year the oysters are collected by divers.

Girls dive to the bottom, collect a small hand net full of oysters, bring them to the surface, and empty their nets into tubs. When the tubs are full, they are emptied into boat tenders.

The "mother oysters," which are used for pearl culture, are wedged open and kept in containers filled with sea water. Each one is then placed in a special holding device while the nucleus is being inserted. Trained girls make an incision in the foot portion of the oyster and place the nucleus in the incision with a piece of living mantle tissue from another oyster. Depending upon the size of the oyster, more than one nucleus may be inserted into a single oyster. The living mantle tissue first forms a sac around the nucleus and then continues to lay coatings of naere around the nucleus.

About fifty oysters with their inserted nuclei are placed into a wire cage which is hung from large bamboo rafts floating in the bays of southern Japan. Periodically the baskets are removed to inspect the oysters and to remove barnacles and possible parasites. The mother oyster remains in the cage from one to five years before the cultured pearl is harvested; three years is about the average length of time required to produce a cultured pearl. About 0.3 millimeter of naere is deposited each year on the nucleus.

At the proper time, usually from October to January, the oysters are removed from the cages and the cultured pearls removed. The size of the pearl produced depends upon the size of the introduced nucleus, the duration of the growth period, and the vitality and age of the oyster.

The pearls are graded and sorted according to size, color, and lustre. At a winter auction buyers from all over the world bid on the pearls, which are exported to various countries throughout the world. In 1965 fifty-five million dollars worth of cultured pearls were exported from Japan, the United States being the chief buyer, followed by Switzerland and West Germany. This was 37% of the total value of all Japanese marine products exported.

There are artificial pearls on the market today that closely resemble cultured pearls. However, they are inexpensive glass or plastic beads which have been painted with a paste made from fish scales.

One-third of the cultured pearls produced in Japan today have their origin from Wabash River mussel shells. This river currently produces the most valuable shells in the United States. There are only two places in the world that have suitable freshwater shells for producing cultured pearls; one is the Mississippi River Valley, and the other is a river system in Red China. Presently Japan purchases all of its freshwater shells from the United States.

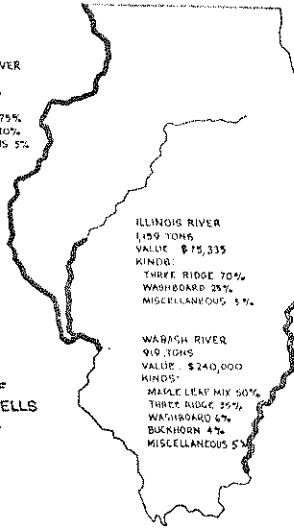
The cultured pearl is a unique and valuable gem. The simple string of cultured pearls which adorn milady's neck is the product of Oriental ingenuity and patience.

MISSISSIPPI RIVER
 181 TONS
 VALUE \$11,765
 KINDS:
 WASHBOARD 75%
 THREE RIDGE 10%
 MISCELLANEOUS 15%

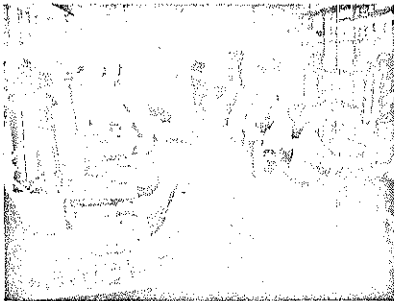
ILLINOIS RIVER
 1,159 TONS
 VALUE \$75,335
 KINDS:
 THREE RIDGE 70%
 WASHBOARD 25%
 MISCELLANEOUS 5%

WABASH RIVER
 919 TONS
 VALUE \$240,000
 KINDS:
 MAPLE LEAF MIX 50%
 THREE RIDGE 25%
 WASHBOARD 4%
 BUCKHORN 4%
 MISCELLANEOUS 17%

HARVEST OF
 MUSSEL SHELLS
 IN ILLINOIS
 FOR 1965



INSPECTING for imperfect pellets.



SHELL STRIPS are cut in cubes.

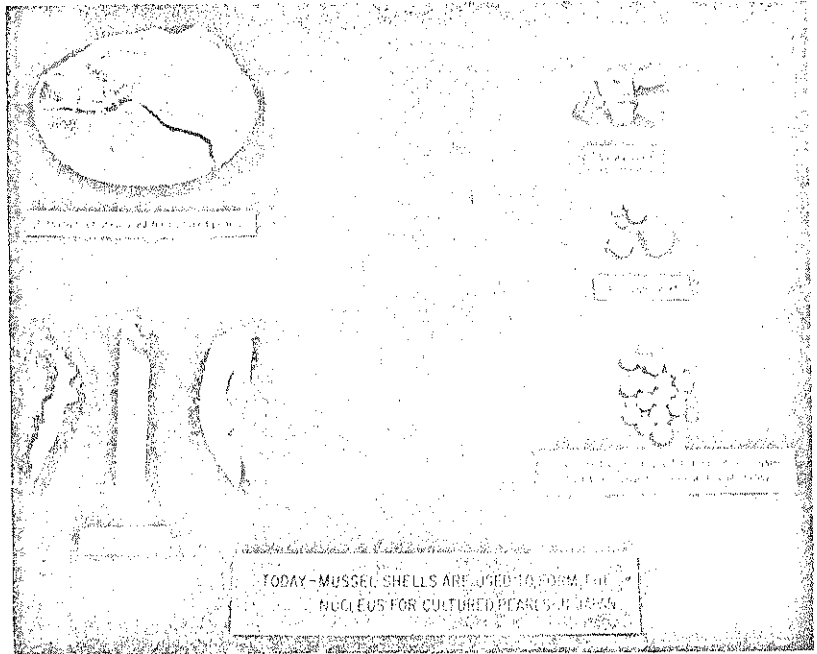


CUBES are ground into pellets.

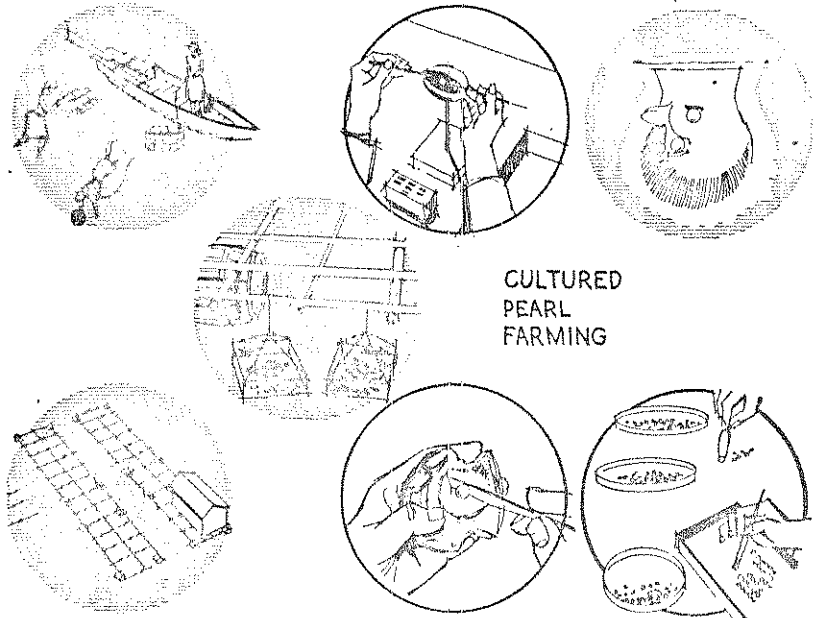


PELLETS are finely polished.

FRESHWATER MUSSELS from the Wabash River are shipped to Japan where thickest portion of shell is cut into strips, then cubes. After cubes have been ground into round pellets they are polished and ready for insertion into oyster as kernel, or nucleus, of cultured pearl. One-third of the cultured pearls produced in Japan have their origin from Wabash mussel shells.



FIVE STEPS in preparation of cultured pearl nuclei from mussel shells.



FAR FROM the sycamore-lined Wabash, in southern Japan, pearl farmers send girl divers to bottom to collect three-year-old oysters. Nucleus made from freshwater mussel is inserted in foot portion of oyster, and oyster is placed into wire cage which hangs from large bamboo raft. The "mother oyster" remains in cage from one to five years before enough nacre is deposited to form cultured pearl.