Dept. of Commerce and Labor

Mussel Resources of the Holston and Clinch Rivers of eastern Tennessee

Boepple, J. H.

DEPARTMENT OF COMMERCE AND LABOR
BUREAU OF FISHERIES
GEORGE M. BOWERS, Commissioner

MUSSEL RESOURCES OF THE HOLSTON AND CLINCH RIVERS OF EASTERN TENNESSEE

Investigation by J. F. BOEPPLE
Notes compiled by R. E. COKER, PH. D.

Bureau of Fisheries Document No. 765

WASHINGTON
GOVERNMENT PRINTING OFFICE
1912

MUSSEL RESOURCES OF THE HOLSTON AND CLINCH RIVERS OF EASTERN TENNESSEE.

Investigation by J. F. BOEPPLE.
Notes compiled by R. E. COKER, Ph. D.

Early in October, 1909, Mr. J. F. Boepple, shell expert in the employ of the United States Bureau of Fisheries at the biological station at Fairport, Iowa, entered upon a brief investigation of the mussel resources of the Holston and Clinch Rivers of eastern Tennessee. Mr. Boepple having died before his notes were compiled for publication, the information he obtained has been assembled in the present form.

HOLSTON RIVER, NEAR MORRISTOWN, TENN.

The investigations were begun by Mr. Boepple in the vicinity of Morristown, Tenn., where a pearl fishery was then in progress. One of the regular pearl seekers having been secured as a guide, a visit was made to the Holston River at Three Springs, about 14 miles distant from Morristown, where the piles of discarded shells were first examined. Despite the fact that the only object of the fishery as pursued at this place was the quest of pearls and the fishermen were ignorant of the market value of shells, it was observed that the discarded shells had a substantial commercial value for the purpose of button manufacture. Examination of the mussel beds of the river was also made, the principal shells obtained being muckets with some three-ridges and a few long niggerheads. An interesting feature of the beds at this point was the presence of numbers of very young mussels which were found to hang from other shells "by threads as fine as the filaments of a spider web." Several of them fell off as the shells were brought from the water into the boat. Some of these juvenile specimens as identified in the field were fluted shells and muckets.

Collecting in the river was pursued at various places, the result being about the same in each instance; muckets were always the principal shell taken. There were several small islands overgrown with rushes where feeding places of the muskrats were found, and

at such points many small shells were taken. It was noted by Mr. Boepple that a number of live mussels were found at these places; this was taken to mean either that the muskrats held a reserve supply or, as he considered more probable, that they were unable to open some of the specimens. Small mussels were also found on the stones in the river.

After working for two days at this point a collection of 100 pounds of shells was taken to Morristown for more careful examination with reference to commercial value.

The following description of the river is copied from Mr. Boepple's field notes:

> The Holston River is at this place quite a large stream a quarter of a mile wide, yet not deep, from 1 to 3 feet. The bottom of the stream is of gravel and rock, at places flat rock, and at some points in the shoals only rock. It was hard to get to these places with a small boat, yet my helper knew every point in the stream. The water was almost clear, yet somewhat milky, and one could see only about 4 feet deep. The banks were bluffs. On the north side one could see the Clinch Mountains in the background. There were likewise places in the river one-half to 1 mile in length where the river was narrow and deep and practically without current.

Previous to this visit a report had been received that pearls were being fished on the Holston, Clinch, and Powell Rivers and that the shells were being thrown into the river as without value. This report was fully substantiated, for wherever examination of the bottom could be made numbers of dead shells were observed that had evidently been thrown back into the river by the pearl fishers after examination for pearls; likewise large piles of shells amounting to several tons in each pile were seen in places on the main bank and on the shores of the islands. After careful examination of these heaps it was found that about 60 per cent of the discarded shells were good muckets, about 20 per cent long niggerheads, while a considerable number were three-ridges.

Some information was obtained in regard to the pearl fishery. During the three years immediately previous there had been 10 to 12 men fishing for pearls in this vicinity, often working for two or three weeks before finding anything of real value. Mr. Boepple was informed by his guide, a reliable pearl fisher, that during these three years he had found one pearl for which he received $800, another which brought him $410. He had also found several for which he received from $10 to $50 each. A number of pieces which he then had in hand were observed, all of which possessed a good luster. The principal season for pearling is during the months of July, August, and September.

Advice was given to the pearl fishers in regard to what species of the shells possessed a commercial value, and in regard to the market for such material. It was also explained that many of the shells previously discarded were not yet ruined for market purposes; so

that a good return might be obtained by sorting these out until a carload lot was obtained. It was the opinion of Mr. Boepple that although among the dead shells in the river and along the banks many were without value, yet several carloads of good shells could be found. It has been learned since that the information given by Mr. Boepple was availed of, and that a considerable quantity of good shells from this region have reached the market.

Several species of mussels were found to be "spawning" (gravid), namely, muckets, pocketbook, fluted-shells, kidney-shells, and fan-shells. The proper scientific names of these species will be found in a list given below, showing the mussels found at this place with an approximate estimate of the commercial value of the shells. Particular attention was given to a test of the value of the yellow-back and green-striped mussels, which are the principal shells of these beds.

SHELLS COLLECTED IN THE HOLSTON RIVER NEAR MORRISTOWN, TENN.

Common name.	Scientific name.	Commercial value per ton.
Yellow mucket	Lampsilis ligamentina gibba[a]	$79.80
Green-striped mucket	Lampsilis ligamentina	79.80
Large black mucket	do	12.00
Pocketbook	Lampsilis ventricosa	12.00
Fluted-shell	Symphynota costata	.....
Three-ridge	Quadrula undulata	10.00
White pig-toe	Quadrula obliqua	10.00
Niggerhead	Quadrula ebena	15.00
Long niggerhead	do	15.00
Hatchet-back	Lampsilis alata	.....
Spectacle-case	Margaritana monodonta	.....
Black sand-shell	Lampsilis recta	15.00
Elephant-ear	Unio crassidens	.....
Purple pimple-back	Quadrula granifera	.....
Kidney-shell	Ptychobranchus phaseolus	.....
Spike	Unio gibbosus	.....
Paper-shell	Lampsilis gracilis	.....
Sugar-spoon	Truncilla arcæformis	(b)
Oyster mussel	Truncilla perplexa	.....
Rabbit-foot	Quadrula cylindrica	.....
Bullhead	Pleurobema æsopus	10.00
Similar to niggerhead	Quadrula subrotunda	15.00
Ringed pimple-back	Cyprogenia irrorata	15.00
Fan-shell	Dromus caperatus	20.00
Fork-shell	Truncilla lewisii	.....

[a] "Yellow mucket" may include also specimens of *L. orbiculata;* "green-striped mucket" may include both *L. ligamentina* and *L. ligamentina gibba.*

[b] Of value for souvenir or fancy articles.

Seven valves, or three and one-half complete shells, give a weight of 1 pound, and produce 8 dozen button blanks, according to which test 100 pounds would produce a little more than 57 gross of 168 blanks per gross. Estimating the material at a conservative figure of 7 cents a gross makes the value of 57 gross $3.99, or the value of the blanks from a ton of shells $79.80. The black muckets are not equal in quality to the other muckets, which are indeed exceptionally fine. The black muckets show many spots which would cause considerable waste. Yellow muckets and green-striped muckets constituted 40

per cent of the catch, while 20 per cent were large black muckets and 20 per cent three-ridges. It will be understood that the valuation was based on the contemporary market, that a number of species were not tested out, and that the figures are to be taken as being only approximately correct.

A later and more careful valuation of species is given below:

Common name.	Scientific name.	Number blanks per pound of shells.	Gross per ton.	Size of blanks.	Value per gross.	Value of blanks per ton of shells.
				Lines.	*Cents.*	
Yel ow mucket	Lampsilis ligamentina gibba	93	1,107	20	7	$77.49
Mucket	Lampsilis ligamentina	37	440	20	5	22.00
Flat niggerhead	Quadrula coccinea	61	799	18	3	23.97
(Not given)	Species uncertain	33	392	20	4	15.68

HOLSTON RIVER, NEAR STRAW PLAINS, TENN.

After a week spent in completion of the investigation in the vicinity of Morristown, a visit was made to Straw Plains, Tenn., where it was understood that a pearl fishery was prosecuted. The Holston River had then risen about 2 feet and the water was very yellow and muddy. Heaps of mussel shells were observed on the banks, but the fishermen had left this place and were found at a point on the river 3 miles above Straw Plains.

Observations were made of the piles of shells about the camps of the fishermen; the shells looked quite fresh, but were then partly submerged by the rise of the river. Unfortunately, it was not possible to work on the beds in the river, since no sound boat was available. It was noted that about 65 per cent of the shells taken by the pearlers were good muckets of like value with those collected at Three Springs. The niggerhead shell occurred in the proportion of about 15 per cent, while other species were present in limited quantities. A considerable number of the shells were taken to Knoxville, where there was opportunity to sort and observe them more carefully.

The following is a list of species collected:

SPECIES OF MUSSELS COLLECTED IN HOLSTON RIVER, NEAR STRAW PLAINS, TENN.

Common name.	Scientific name.	Common name.	Scientific name.
Pig-toe	Quadrula obliqua.	Kidney-shell	Ptychobranchus phaseolus.
Golf-stick	Obovaria retusa.		
Black sand-shell	Lampsilis recta.	Fluted-shell	Symphynota costata.
Elephant-ear	Unio crassidens.	Pimple-back	Quadrula pustulosa.
Niggerhead	Quadrula ebena.	Long pimple-back	Quadrula pustulosa.
Pocketbook	Lampsilis ventricosa.	Sugar-spoon	Truncilla arcæformis.
Three-ridge	Quadrula undulata.	Large mucket	Lampsilis ligamentina.
Purple pimple-back	Quadrula tuberculata.	Green-striped mucket	Lampsilis ligamentina.
Fan-shell	Dromus caperatus.	Yellow-back mucket	Lampsilis ligamentina gibba.
Hatchet-back	Lampsilis alata.		
Paper-shell	Lampsilis gracilis.	Spike	Unio gibbosus.

HOLSTON, FRENCH BROAD, AND TENNESSEE RIVERS, NEAR KNOXVILLE, TENN.

Through the kindness of Mr. Curtis, a jeweler and pearl dealer in this city, there was opportunity to examine a valuable local collection of pearls and baroques. It was desired also to examine the French Broad River, near its union with the Holston River, where they form the Tennessee, and a boat and competent guide having been secured, Mr. Boepple proceeded up the French Broad a distance of 5 miles to the shoals. The beds were then examined by working down stream. With each haul four to six mussels were obtained, chiefly the elephant-ear. It was reported that at a distance of 20 miles up this stream a large proportion of good white shells were obtainable.

After entering the Tennessee River similar conditions prevailed, only elephant-ears and a very few white shells being taken. It was learned that below Knoxville there was a shoal with gravel bottom where many mussels were to be found, but without pearls. Consequently the local informant had no knowledge of the varieties of the shells constituting this bed. A few days later it was found practical to visit the shoals referred to. A haul was begun at a point 200 feet above the shoals and continued through the shoals into the quieter water below. Each haul extended over a distance of 20 to 50 yards and each time 12 to 24 mussels were taken on a drag bearing 48 hooks. This was the condition just above and on the shoals. Mussels were obtained throughout the entire width of the river, and some were taken in the quieter water below. After the boat was filled with mussels, a count showed that 90 per cent were elephant-ear and 10 per cent pig-toes, muckets, and others.

The elephant-ears have no value, pig-toes were of the same value as corresponding shells of the Ohio River. The monkey-face corresponds in value to the pig-toes; white pimple-backs were comparable to niggerheads in value. Muckets were of poor quality, the shells being so thin as to produce chiefly tips, while the thicker part had little luster, was chalky, and accordingly not susceptible of polish. They were also partly spotted. A list of shells taken in the vicinity of Knoxville is given below:

SPECIES OF MUSSELS COLLECTED IN VICINITY OF KNOXVILLE, TENN.

Common name.	Scientific name.	Common name.	Scientific name.
French Broad River.		*Tennessee River, 4 miles below Knoxville.*	
Elephant-ear	Unio crassidens.	Elephant-ear	Unio crassidens.
Mucket	Lampsilis ligamentina.	Pig-toe	Quadrula obliqua.
Pig-toe	Quadrula obliqua.	Mucket	Lampsilis ligamentina.
Niggerhead	Quadrula ebena.	Monkey-face	Quadrula metanevra.
Tennessee River below the Forks.		Pimple-back	Quadrula pustulosa.
Elephant-ear	Unio crassidens.	Purple pimple-back	Quadrula tuberculata.
Mucket	Lampsilis ligamentina.		
Pig-toe	Quadrula obliqua.		
Pocketbook	Lampsilis ventricosa.		

The French Broad River is described as being navigable, the channel having been improved in some places through the construction of dams by the Government; the bottom is coarse gravel; in places the river is bordered by farm land, while in other places steep cliffs of rock border the stream. Marble quarries were noted. Marble banks were also observed along the Tennessee River, while the bottom of the stream was a coarse gravel.

The presence of marble or limestone along the banks or the bed of a stream constitutes a most favorable factor for mussel growth, since the erosion of the rocks keeps the water supplied with the carbonate of lime, which is the principal constituent of the shell. The stream was quite large and, except on the shoals, quite deep; there were places where the bottom could not be reached with a sounding pole 10 feet in length. Not one mussel was observed to be gravid, although it was thought that the mussels of some species were preparing to spawn.

It was found that pearls were bought and sold on the streets of Knoxville. Private collections were also observed, and a wide variety of pearls and slugs of good quality were seen. Since it was learned that most of the pearls come from the Clinch River, Mr. Boepple proceeded at once to make an examination of the mussel beds of that river from Dutch to Clinton, Tenn.

THE CLINCH RIVER FROM DUTCH TO CLINTON, TENN.

Investigations on the Clinch River were begun October 25, 1909, at Dutch, Tenn., near the railroad bridge, where shells could be taken by wading. The water was sufficiently clear to distinguish mussels on the bottom at a depth of 2 feet, but they were found to be very scattering. At the Sycamore Shoals fishing was undertaken with the rake. Chiefly small mussels were found both above the shoal and in the shoal, but not immediately below.

The bottom of the river here was of rough gravel and sand; there were a good many reefs ("hogbacks") and in some places the rocky bottom took the form of steps, over which it was difficult to work the small boat. Between the reefs the water was so clear that mussels could be seen at a depth of 4 feet. On both banks were bluffs of limestone rock.

The following mussels were found to be in breeding condition: Muckets (*Lampsilis ligamentina*); yellow-back muckets (*L. ligamentina gibba*); pocketbook (*L. ventricosa*); a small mucket, species uncertain; a fluted-shell (*Symphynota costata*); oyster mussel (*Truncilla perplexa*); the black sand-shell (*L. recta*). Large numbers of mussels discarded by the pearl fishers were observed in the river, and a little farther down were piles of shells on the banks containing as much as 2 tons, 75 per cent of which were shells of the best muckets.

The investigation was continued by working down the river in a small rowboat with a competent local guide. On the following day, after collecting on many small shoals, the party reached Walker's ferry, where a remarkably abundant mussel fauna was encountered. Although the water was very clear it was difficult to see the mussels on the bottom, and they were best taken with the rake. Several tests were made by digging holes in the bottom, and mussels were found in every case. In one instance a hole 2 feet wide by 2 feet long was excavated for a depth of 10 inches, and 66 mussels, representing 10 different species, were taken. This represents an average of 16 mussels to the square foot of bottom surface, a very remarkable degree of abundance.

The following table indicates the approximate proportions in which the chief species occurred:

	Per cent.
Mucket	30
Long niggerhead	10
Fluted-shell	20
Pig-toe	10
Various small species	30

A little farther down the river deeper water was encountered and the crow-foot dredge was employed to advantage, taking large muckets and pocketbooks. As before, mussels were found just above the shoals and on the shoals. In every small shoal examined in this vicinity it appeared that the greater part of the best shells had been opened and thrown away by the pearl hunters. Although the shells were muddy and dirty, they were found to be in good condition for button manufacture.

The commercial value of such shells was explained to the pearl hunters, who were advised to seek a market for this material. It was learned that few pearls had been found during the preceding summer, so that a market for the shells was practically necessary to supplement the income from the yield of pearls. It was estimated that about three-fourths of the open mussels were of good commercial value and that 2 carloads of shells could be obtained in the immediate vicinity.

The character of the bottom of the river and banks corresponds to that hitherto described. The following species were observed to be in breeding condition: Mucket (*Lampsilis ligamentina*), pocketbook (*L. ventricosa*), black sand-shell (*L. recta*), fluted-shell (*Symphynota costata*), oyster mussel (*Truncilla perplexa*), sugar-spoon (*T. arcæformis*), kidney-shell (*Ptychobranchus phaseolus*), and others.

Large piles of shells made by the muskrats were examined on an island, where it was noted that about one-third of the shells were the spectacle-case (*Margaritana monodonta*). From this point down, the spectacle-case was found to be more abundant than before. Long

Meiers Shoal was found to have abundant mussels, and on other shoals several miles lower on the river, where the water was shallow (6 to 18 inches deep) and rapid over a rough bottom, there were observed large numbers of the best shells, which had been recently discarded by pearl hunters. Examination of the bottom by means of the rake was made in many different places, but practically no shells were found except the finest muckets. It was estimated that a carload of shells could be obtained in that vicinity.

At a point 5 miles lower, where the river bottom was composed of rocks and small gravel, mussels of large size were found. On the 29th, Cloud Shoals was reached and investigated. On account of the compactness of the bottom, the rake formerly used was discarded for a common pitchfork, with which the mussels could be more easily obtained. Various species were found, but the chief shell was the mucket. Elephant-ear and fluted-shells were observed to be decreasing in abundance the farther the investigation was continued down the river.

A little lower on the river a pearl hunter was observed taking the mussels by the rather crude method of using an iron hook to pry the mussel from the bottom and push it into a tin can that was lowered to the bottom. He reported that pearls were more frequently found in mussels taken from the deep water, possibly because the older and larger shells were to be found in such a location.

Mr. Boepple was informed of a unique method of mussel fishing sometimes pursued in that vicinity. By using a plow drawn by a strong team and working where the water had a depth of 4 to 12 inches, the bottom is thoroughly plowed up so that the mussels can easily be picked from the surface.

Another good mussel shoal was found just before reaching the mouth of Powell River, a short distance from Agee.

A brief examination was made October 30 of the lower portion of the Powell River, the bottom of which, in this region, is described as being of limestone and gravel. One bank is rocky, with high bluffs, while the other is bordered by good farming lands. Mr. Boepple employed a pair of tongs, somewhat similar to blacksmith's tongs, with which he could work in 5 feet of water. The chief mussels taken in the lower portion of the river were three-ridges and fluted-shells. A little higher up a great many muckets, black sand-shells, three-ridges, and hatchet-backs were encountered. Three pearl fishers working together in one boat were found prosecuting their work, two men manipulating the boat, while the third collected the mussels, using a small fork with long handle.

The mussels of the Powell River have not so high a commercial value as those of the Clinch. The muckets, which were mostly old mussels, constituted about one-fourth of the shells. The three-ridges were listed as without commercial value.

Working at a point on the Clinch River a quarter of a mile above its mouth, it was observed that along the banks chiefly small mussels were found, while in the middle portion of the river large examples of muckets, niggerheads, and pocketbooks could be taken. The shells were found in the bottom at a depth of from 1 to 10 inches; it was thought that the mussels buried themselves on account of the low stage of the water. Below Agee the bottom was composed mostly of large rocks instead of shoals and gravel, the mussels lying between the rocks. Many fine large mussels could be taken by using the tongs.

As the investigation was continued down the river, October 31 and November 1, many shoals were examined, as well as the piles of mussel shells made by muskrats or by pearl hunters along the river banks. Pearl hunters were observed taking mussels with the use of a long stick, which was inserted into the opening of the shell and upon which the mussel would close and hold with sufficient firmness to be brought up to the surface. Small dip nets were used to pick up mussels that were lying on the rocks. Another method was the use of a long pike-pole, on the handle of which was a steel spring which could be pushed down over the mussel. At this point, only a short distance above Clinton, the three-horned warty-back, golf-stick, and butterfly were first encountered.

About 1½ miles above Clinton a shoal called Moores Ferry was carefully examined. On one side the bottom was composed of a very soft gravel, in which no mussels were found. About 50 feet from the bank, however, the gravel was firmer and there were mussels. On the whole, very few mussels were taken, and it was thought that the beds were practically exhausted as the result of the persistent fishery in the region of Clinton. Lower down the river piles of mussel shells were found, which had been taken by pearl hunters working where the water had a depth of 10 to 15 feet.

COMMERCIAL VALUE OF MUSSELS FROM THE CLINCH RIVER.

Mr. Boepple rated the mussels of the Clinch River as having particularly high market values. The niggerhead is not quite so good as the Ohio River niggerhead, but it should bring a fair price. The pig-toe of the Clinch River is of much better quality than those of the Ohio River; the black sand-shell is of extra fine quality. The sugar-spoon and oyster mussel could be used for very small buttons; the white pimple-back is of moderate value, and the fan mussel produces good buttons, though its color in this region turns to common pink. Mr. Boepple made the following statement in his notes: "The Clinch and Holston Rivers have the best mussels for buttons that I have seen in all my experience in the button business."

The following table includes the result of commercial tests of shells taken from the Clinch River near Clinton, Tenn., and from

Powell River. The diameter of blanks is expressed in "lines" (1 line = $\frac{1}{40}$ inch), and "T" in the columns indicates "tips," uneven blanks of poor quality.

COMMERCIAL VALUATION OF MUSSEL SHELLS TAKEN FROM CLINCH AND POWELL RIVERS.

Common name.	Scientific name.	Quantity of shells tested.	Number of blanks obtained.	Number of gross blanks estimated per ton.	Size of blanks.	Value per gross.	Value of blanks per ton of shells.	Number of shells (pair) used for test.
CLINCH RIVER.								
Anderson County near Clinton.								
		Lbs.			*Lines.*	*Cents.*		
Bull head	Pleurobema æsopus	½	22	523	20	4	$20.92	5½
Kidney shell	Ptychobranchus phaseolus	2	164	976	16	2	19.52	14
Pig-toe	Quadrula obliqua	2	8	46	36	18	8.28	9
		2	9	53	30	12	6.36	9
		2	47T	279	16	1	2.79	9
Ringed warty-back	Cyprogenia irrorata	2	18	107	30	10	10.70	13
		2	58	345	18	3	10.35	13
Pocketbook	Lampsilis ventricosa	2	60	357	24	5	17.85	5
		2	69	410	16	1	4.10	5
Black niggerhead	Quadrula coccinea?	2	82	488	20	6	29.28	(a)
Pig toe	Quadrula obliqua	1	38	452	20	4	18.08	5
Yellow-back mucket	Lampsilis ligamentina gibba	5	142	338	24	8	27.40	9
		5	311	740	20	7	51.80	17½
Black sand-shell	Lampsilus recta	2	20	119	24	4	4.76	.....
		2	148	880	16	2	17.60	.....
Union County.								
Pimple-back	Quadrula pustulata	1	82	976	16	3	29.28	.....
Yellow-back mucket	Lampsilis ligamentina gibba	5	360	857	20	7	59.99	19½
		5	46	119	35	15	16.35	10
		5	118	280	20	6	16.80	10
Pocketbook	Lampsilis ventricosa	2	89	529	20	3	15.81	.....
Grandma	Lampsilis ovata	2	94T	559	16	1	5.59	.....
Black sand-shell	Lampsilis recta	1	10	119	24	4	4.76	.....
		1	71	845	18	3	25.35	.....
Grainger County.								
Black sand-shell	Lampsilis recta	1	16	190	24	4	7.60	.....
		1	57	678	16	2	13.56	.....
	Quadrula coccinea	1	67	799	18	3	23.97	.....
	Quadrula coccinea, small	1	124	1,476	16	2	29.52	.....
Ringed warty-back	Cyprogenia irrorata	1	48	571	20	4	22.84	.....
POWELL RIVER.								
Campbell County.								
Three-ridge	Quadrula undulata	5	204[d]	485	20	2	9.70	.....
Black sand-shell	Lampsilis recta	1	10	119	24	4	4.76	.....
		1	68T	800	18	1	8.00	.....
Yellow-back mucket	Lampsilis ligamentina gibba	5	19	45	35	15	[b]6.75	.....
		5	140	326	20	5	[b] 16.30	.....
		5	45	107	30	12	[c] 12.74	.....
		5	228	542	20	4	[c] 21.68	.....

[a] Not stated. [b] Large. [c] Small. [d] Second grade blanks and tips.

It will be noted from the above table that the same lot of shells was in some cases tested for two sizes of blanks, as in the case of the last lot of *L. ligamentina gibba,* or yellow-back mucket, shown in the table. The shells were first tested for 30-line buttons, and the

value of the blanks obtained was estimated to amount to $12.74; the remaining parts of the same shells were then used again, cutting out 228 blanks and tips of 20 lines and the value of these was estimated at $21.68 per ton of shells. Thus, if the shells were worked twice for the two sizes of blanks, the total value of the product obtained would be $34.42 per ton. The shells were not especially selected for testing and the results should give an approximately correct idea of the commercial value of the mussels of the Clinch River from the region investigated, after making all necessary allowances for handling, transportation, etc.

As far as known no shells had been shipped for the button market prior to the time of Mr. Boepple's investigation, although at that time some shells were being collected near Clinton, and a single car of shells reached the market late in that season, 1909. Pearls had been sought for a great many years, but the value of the shells was entirely unappreciated. It required some time, in fact, for the residents to realize that this neglected resource was of substantial value. In the following seasons, 1910 and 1911, several carloads were collected and sold for button manufacture. During the season of 1912, as is understood, the search for shells is being pursued with greater vigor, even up into the headwaters of these rivers, in the Appalachians, and it is expected that larger shipments will be made.

The streams are small and can not make a significant bulk yield, but the quality of the shell product, as well as the value of the pearls, is such as to justify careful attention to the fishery and the proper protection of the beds from depletion.

○