

DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES
HENRY O'MALLEY, Commissioner

THE KENTUCKY RIVER AND ITS
"MUSSEL RESOURCES

By ERNEST DANGLADE
Formerly Field Assistant, U. S. Bureau of Fisheries

APPENDIX XI TO THE REPORT OF THE U. S. COMMISSIONER
OF FISHERIES FOR 1922



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CONTENTS.

	Page.
Kentucky River and its three upstream forks.....	1
Shipping facilities.....	2
Mussel beds.....	3
Mussels.....	5
Pearls.....	7
Methods of mussel fishing.....	7
Summary.....	7

KENTUCKY RIVER AND ITS THREE UPSTREAM FORKS.

The basin of the Kentucky River is situated in the eastern portion of Kentucky and embraces about one-sixth of the State, or approximately 6,700 square miles. The mountain sections, which are within the Cumberland Plateau, are rough and uneven, varying in elevation from 1,000 to 3,200 feet. The lower two-thirds of the basin descends gradually from 1,000 to about 450 feet. Omitting the small tributaries leading down from the mountains, the river has a fall of about 800 feet, an average of 2 feet per mile. The upper third of the stream has a fall of about $3\frac{1}{2}$ feet per mile; the remainder of about 0.9 foot per mile.

The headwaters of the river, consisting of three branches, the North, Middle, and South Forks, have their sources along the northern slopes of Pine Mountains. The streams flow in a general northwesterly direction and unite near Beattyville to form the main stream which continues in the same direction and flows into the Ohio River at Carrollton. Including North Fork the river has a length of about 400 miles, but in a direct line from source to mouth the distance is about 175 miles. The difference of 225 miles is due to numerous windings and bends, including two large sweeps, one to the north and one to the south.

It is interesting to note that the Cumberland and Big Sandy Rivers have their origins on the slopes of Pine Mountains and that the headwaters of these streams are but a few hundred yards from those of the Kentucky.

The river holds the center of the basin from its source to below Valley View, a distance of about 240 miles, whence it bears decidedly westward, especially from High Bridge to the mouth. The width of the stream is from 75 to 250 feet and the depth from a few inches to 4 or 5 feet in the upper stretches during low water up to 40 or more feet in the lower river in times of flood. The banks are moderately low and are composed of mud, loam, or solid rock. The bottom lands, which are generally rather narrow, are fertile and

¹Appendix XI to the Report of the U. S. Commissioner of Fisheries for 1922. B. F. Doc. No. 934.

extensively cultivated. The bed of the stream in the upper divisions consists of a series of rilles or shoals having a solid or shingle rock floor and long reaches of sand foundation in the pool areas. Through the presence of 11 locks and dams, maintained by the Federal Government, the main stream or the lower two-thirds of the river is in pool stages and has, for the most part, a soft mud bottom.

The river basin contains five geological formations. The first, located in the southeastern portion, is the Subcarboniferous formation. It is represented by the Pine Mountains, which form a long, narrow band or elevation rising above adjacent sandstone areas, and is composed mostly of limestone, a mineral of first importance in the nutrition of the heavy-shelled fresh-water mussels. The next is the Carboniferous, with extensive deposits of an excellent quality of coal. The other formations, composed mainly of limestone, are in order as follows: the Devonian, the Silurian, and the Ordovician. Since the Subcarboniferous comes to the surface toward the north as well as in the mountains, it would appear that the Carboniferous occupies and fills a broad, deep, and extensive valley of limestone—the Pine Mountains on the southeast and the Blue Grass region on the northwest. The waters flowing through this region are rather hard, obtaining their soluble calcium compounds, which are essential to mussel growth, from these extensive deposits of limestone.

Besides the three principal forks, there are many small side streams and creeks flowing into the river. The largest of these are the Red River and Eagle Creek from the east and the Dix River from the south.

The water of the Kentucky is more or less turbid at all seasons of the year. During periods of heavy rainfall there is considerable crude oil wastage from the adjacent oil fields spreading over the river's surface. Other than this, however, there is not an undue amount of pollution contaminating the water and detrimental to aquatic life.

SHIPPING FACILITIES.

The following list gives the larger towns along the main river and along the three large upstream forks that have railroad connections:

MAIN KENTUCKY RIVER.

Carrollton	Carrollton & Worthville R. R.
Frankfort	{ Louisville & Nashville R. R. Frankfort & Cincinnati R. R. Chesapeake & Ohio R. R.
Tyrone	Southern R. R.
High Bridge	Do.
Valley View	Louisville & Nashville R. R.
Ford	Do.
Irvine	Do.
Beattyville	Do.

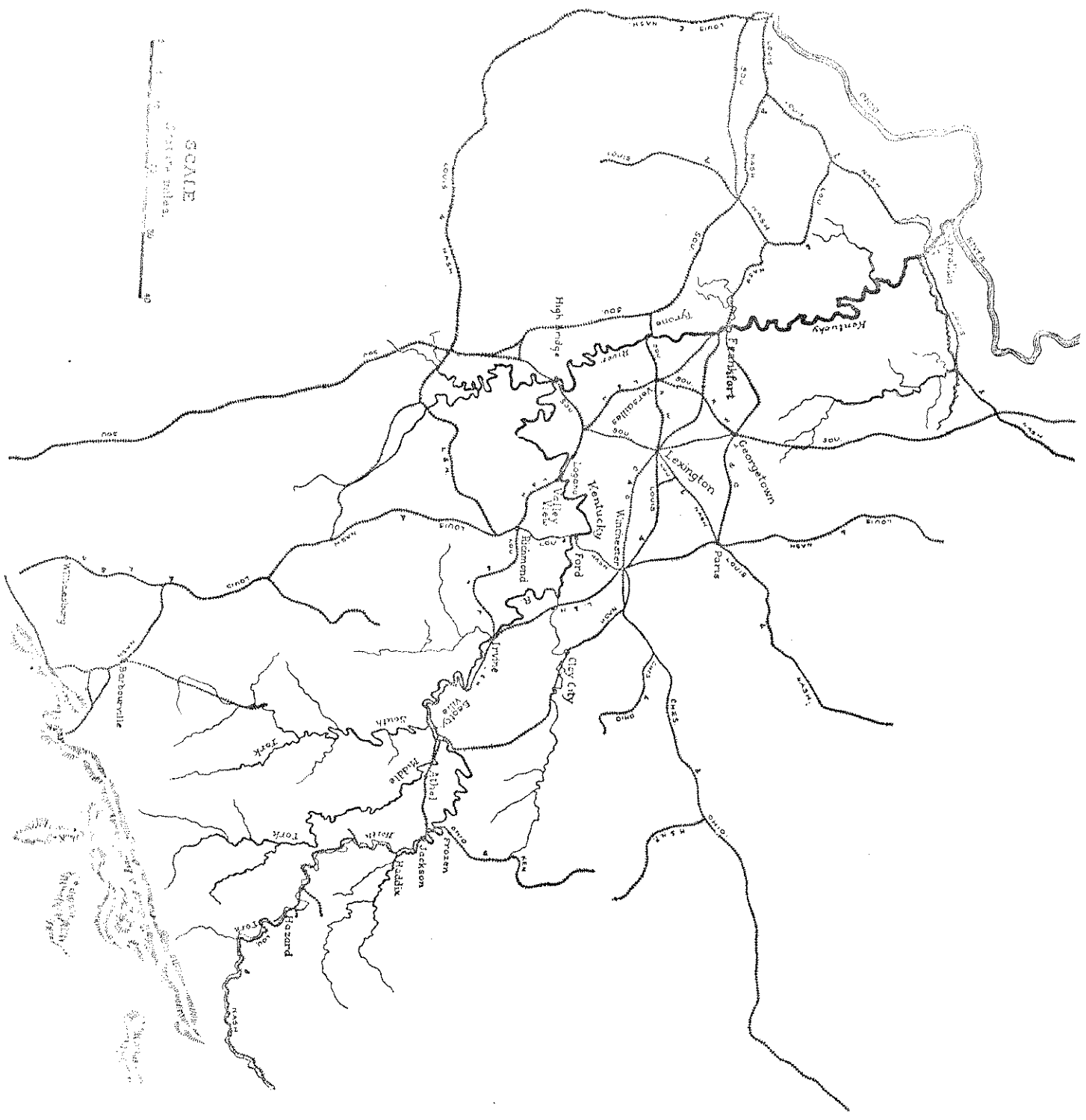
NORTH FORK OF KENTUCKY RIVER.

Jackson	{ Louisville & Nashville R. R. Ohio & Kentucky R. R.
Prozen	Ohio & Kentucky R. R.
Hazard	Louisville & Nashville R. R.

Louisville & Nashville Railroad parallels the stream from Jackson nearly to its source.



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UNITED STATES RAILROAD CONNECTIONS

KENTUCKY RIVER AND ITS MUSSEL RESOURCES.

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MIDDLE FORK OF KENTUCKY RIVER.

Louisville & Nashville Railroad parallels the stream from its mouth to Athol. No railroad connections farther up stream.

SOUTH FORK OF KENTUCKY RIVER.

No railroad connections on this stream. Nearest railroad shipping point is at Beattyville, at the mouth of the Fork.

The railroad shipping facilities are poor for the immediate and direct handling of fishery products except on the North Fork and on the main stream from Beattyville to below Irvine, where the Louisville & Nashville Railroad parallels the channel. The railroad shipping points other than here are located at points from 30 to 50 miles apart and, for their use in shipping, fresh-water mussels would require previous shipment by packet or towboat. Transportation is further facilitated, however, by the 14 Government locks and dams previously mentioned. These agencies to improve river commerce have made the lower 255 miles of the river from Beattyville to Carrollton navigable for steamboats and other craft at all seasons of the year, except during times of heavy ice. Thus by towing or shipping by small boat or packet the railroad points may be quite readily reached.

MUSSEL BEDS.

There are many mussel beds in the upper Kentucky, and, although small in extent when compared with those of the Ohio and Mississippi Rivers, they are generally well stocked and good yielders of commercial shells. The greater portion of the bars occupied by mussels range in area from small patches of a few square yards to 2 or 3 acres or more.

The beds may not be situated in the bends, as is often the case in the Ohio River, but in localities having permanent or but slightly shifting bottoms, in which mussels can burrow and maintain a foothold. The greater number of such grounds, as the riffles or shoals, are found off creeks and small streams or in favorable sections alongshore, usually immediately above the shoals and opposite the channel. The riffles and other mussel-bearing districts are fairly regular in distribution, averaging about two per mile in the most favorable sections. There are four principal classes of shell beds in the headwaters.

- (1) The riffles. When occurring on a bar of this class, the mussels are distributed practically all over it, excepting perhaps in the swifter parts and channel. In some places they are found living for some distance below as well as above the main riffles.
- (2) Areas situated above exposed bars and in the shallower chutes, but seldom in the channel.
- (3) Favorable bottoms at the lower end of long pools or at the beginning of shoals, where the current is slow, but uniform throughout. Also directly above and below fords.
- (4) Sections alongshore; occasionally a portion of a bar extending across the river. On these beds there are usually large bowlders and a shingle or sand-mud bottom. These grounds are generally some distance from the shoals.

There are also small bars and patches here and there on good bottoms and scattering mussels between large adjacent beds where the current is moderate and the bottom is somewhat unstable or else too hard for safe burrowing. Wherever a favorable bottom of any size occurs in the streams mussels are to be found. A good indication of a shell bed, particularly alongshore, is a growth of water willows in moderate current.

The most productive mussel area in North Fork is the stretch from Hazard, Perry County, to Log Shoals, Lee County, a distance of about 75 miles. The following list of beds in North Fork were worked to some extent during the shelling seasons of 1919 and 1920:

Doughty Shoals, 2½ miles above Haddix, Breathitt County.
 Jackson or Coal Chute Bed, Jackson.
 War Shoals, 3 miles below Ohio & Kentucky Railroad Junction.
 St Bend, 2 miles above Frozen.
 Frozen Bed, Frozen.
 Cedar Point Shoals, 3 miles below Frozen.
 War Creek Shoals, near county line between Breathitt and Lee Counties.
 Hieronymus Ford, Lee and Wolfe Counties.
 Hays Bar, Lee County.
 Upper Twin Shoals, 10 miles above Beattyville.
 Tea Table Shoals, off Tea Table Branch, Lee County.
 Aggie Riffle, near Primrose.
 Laurel Shoals, off Laurel Branch, Lee County.
 Log Shoals, off Log Branch and at the head of slack water.

Only limited shelling has been carried on in Middle Fork. The best beds in this stream are as follows:

Mill Creek Shoals and vicinity, near Tallega, Lee County.
 Section between Monica, Lee County, and Athol, Breathitt County.

There are doubtless some good beds above these stretches, but the stream becomes rather small and transportation facilities are unsatisfactory for heavy loads.

No shelling has been done in South Fork. There are small beds in the section of the stream between the head of slack water and Booneville, Owsley County, thence to Bronner Bend, about 5 miles by water above Booneville, and at points above. There are no railroad or steamboat shipping facilities on this fork, and during periods of low stage of water it is impossible to tow heavy loads in small flatboats or barges. This would necessitate hauling overland over rough roads.

As an indication of the productiveness of the upper reaches of the Kentucky River it should be mentioned that during the shelling operations of 1919 two carloads of marketable shells were gathered from the beds of North and Middle Forks and sold at a good price. So far as was determined by an inspection of the grounds, the beds were not injured by the season's industry. In 1920 the stretch from above Haddix to Log Shoals, a distance of about 35 miles, gave a return of 87 tons of desirable shells. Rain, high water, and a general shortage of help prevented a greater yield.

It is not to be understood that the output of these streams will equal that of such rivers as the Cumberland, Wabash, or Illinois, or that the supply will be inexhaustible. It is evident, however, that if fished within reason and at the proper seasons, they will yield an appreciable regular annual return. With continued heavy and undue shelling, they are liable to reach depletion within two or three years.

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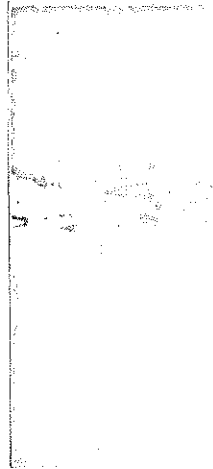


FIG. 2.—NORTH
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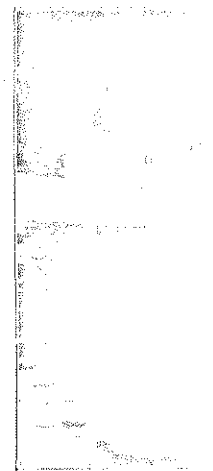


FIG. 3.—NOR
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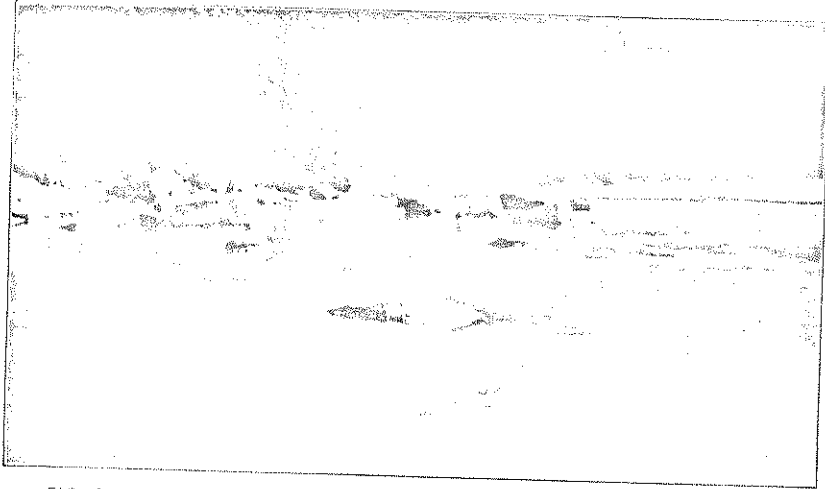


FIG. 2.—NORTH FORK OF KENTUCKY RIVER, 2 MILES ABOVE LOTHAIR.
The bottom is rocky, with some sand and gravel. Only scattering mussels were found.

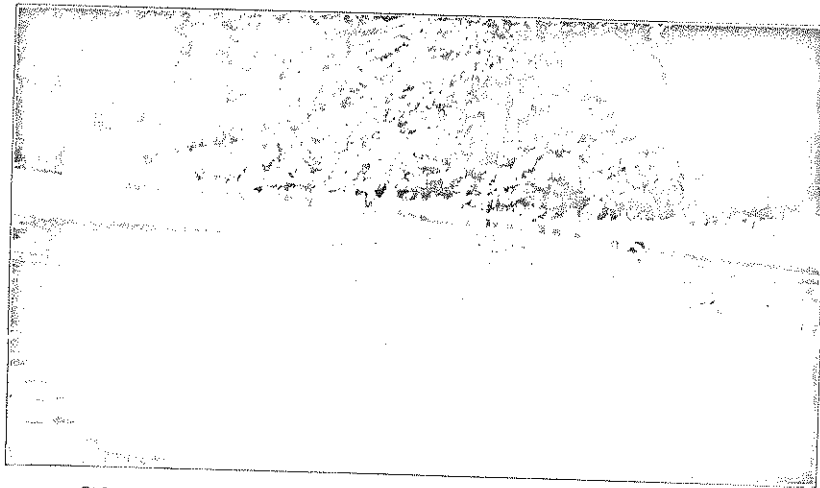


FIG. 3.—NORTH FORK OF KENTUCKY RIVER, DOUGHTY SHOALS.
A fine mussel bed here, mostly mucketts. The best portion of the bed is along the opposite shore where the water is rather deep and has little current. The white streak is water flowing over the riffles.

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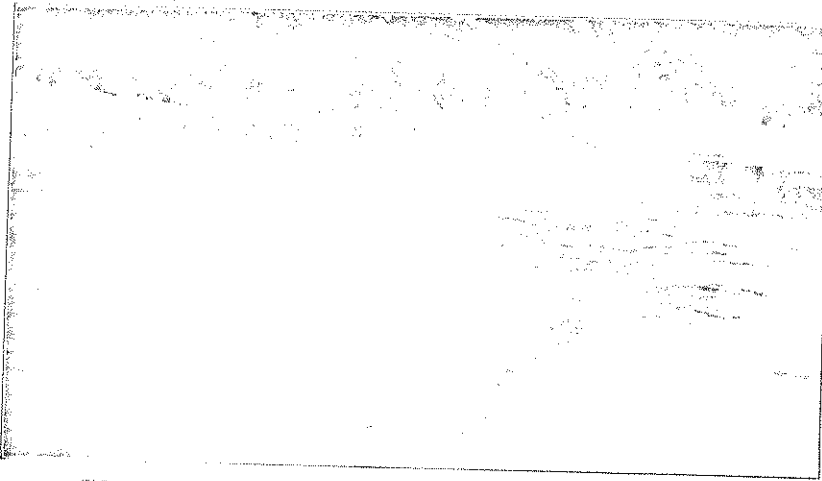


FIG. 4.—NORTH FORK OF KENTUCKY RIVER, DOUGHTY SHOALS.
This shows the riffles and the pool above. The riffles are situated diagonally across the river.

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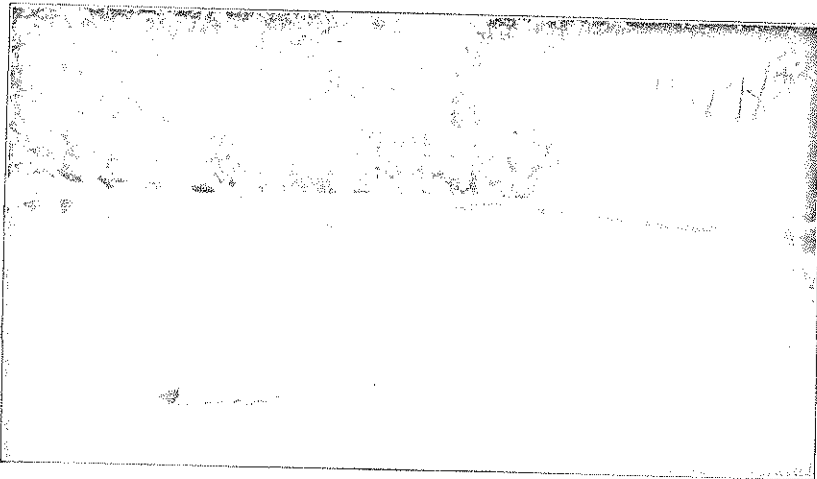


FIG. 5.—SOUTH FORK OF KENTUCKY RIVER, NEAR BRONNER BEND SHOALS.
Some mussels are found here. Bottom rocky, with sand and gravel.

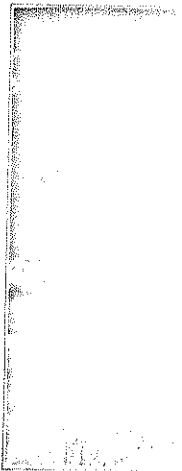


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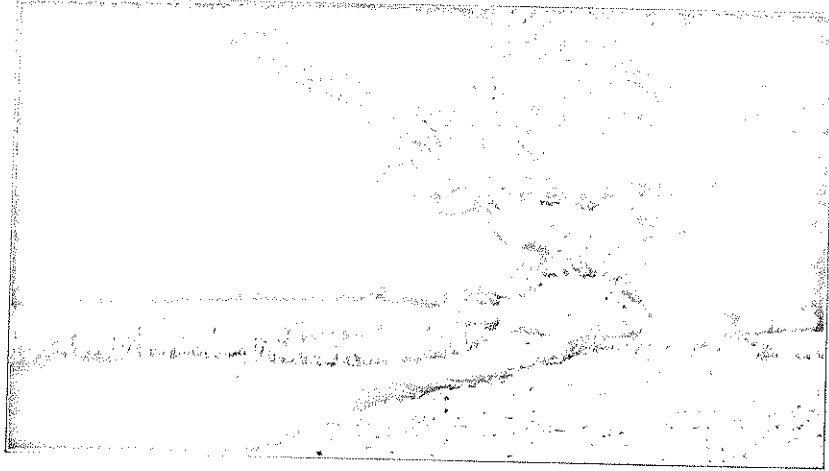


FIG. 6.—SOUTH FORK OF KENTUCKY RIVER, BRONNER BEND SHOALS.

This shows the left chute around a small bar covered with water willows. Mussels, including the *Truncillas*, are found here.

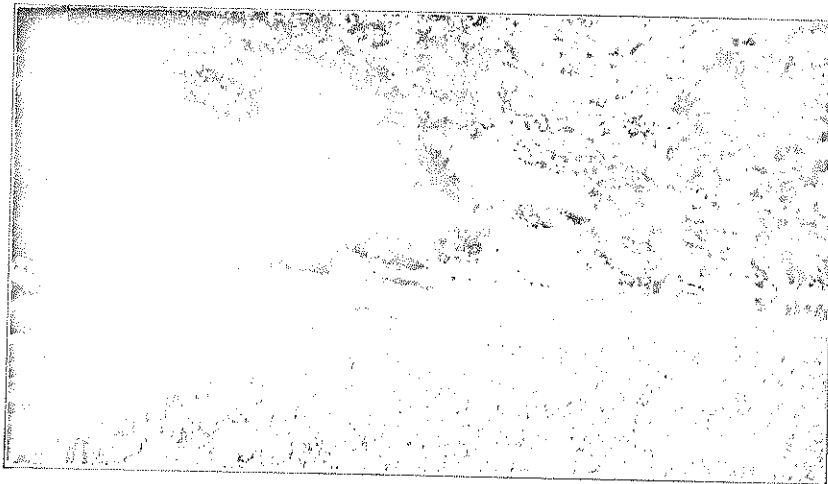


FIG. 7.—SOUTH FORK OF KENTUCKY RIVER, BRONNER BEND SHOALS.

This shows the right chute around a small bar covered with water willows. Mussels are found here.

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MUSSELS.

The mussels of the Kentucky River are neither uniformly nor indiscriminately distributed over a given mussel-bearing area but are found more or less grouped in the sections having standard bottom conditions. They occur, as a rule, more frequently at those places with a penetrable bottom in the quieter waters and near shore than in the swift portions and in the channel. The mussels are often found densely crowded in the beds, standing on end, but so arranged, if possible, that the tips of the shells point upstream.

The 40 species of mussels found in the Kentucky River and here-with listed probably do not represent the number occurring in the drainage or even in the headwaters. Of the 40 listed species 22 are of commercial value in button manufacture. The following table gives the names and comparative occurrence of mussels, weight of shells, and other considerations of value to the mussel fisherman and the manufacturer.

Mussels of the Kentucky River and its upstream forks.

Common name.	Scientific name.	Value as button material.	Number of shells per ton.	Occurrence.
Elk-toe.....	<i>Alasmidonta marginata</i>	None.....		Occasional.
	<i>Alasmidonta minor</i> ¹	do.....		Rare.
Floater.....	<i>Anodonta grandis</i>	do.....		Occasional.
Paper-shell.....	<i>Anodonta imbecillis</i>	do.....		Rare.
Fish-shell.....	<i>Cyprogenia irrorata</i>	Fair.....		Do.
Pink head-splitter.....	<i>Lampsilis alata</i>	None.....		Common.
Yellow sand-shell.....	<i>Lampsilis anodontoides</i>	Very good.....		Rare.
Slough sand-shell.....	<i>Lampsilis fallaxiosa</i>	None.....		Occasional.
Paper-shell.....	<i>Lampsilis gracilis</i>	do.....		Do.
Mucket.....	<i>Lampsilis ligamentina</i>	Very good.....	3,200-7,100	Very common.
Fat mucket.....	<i>Lampsilis luteola</i>	Good.....		Occasional.
	<i>Lampsilis multiradinta</i> ¹	Poor.....		Do.
	<i>Lampsilis parva</i> ¹	None.....		Rare.
Black sand-shell.....	<i>Lampsilis recta</i>	Fair.....		Common.
Pockethook.....	<i>Lampsilis ventricosa</i>	Good.....	3,200-5,300	Do.
Three-horned warty-back.....	<i>Obliquaria reflexa</i>	Fair.....		Rare.
Round shell.....	<i>Obovaria lens</i>	Poor.....		Occasional.
Deer-toe.....	<i>Pagiola denticiformis</i> ¹	None.....		Do.
Club-shell.....	<i>Pagiola elegans</i>	Poor.....		Common.
Kidney-shell.....	<i>Platurobema chava</i>	None.....		Rare.
Flat niggerhead.....	<i>Ptychobrancheus phaseolus</i>	do.....		Do.
Rabbit's foot.....	<i>Quadrula cylindrica</i>	do.....		Occasional.
Purple warty-back.....	<i>Quadrula granifera</i>	do.....		Rare.
Washboard.....	<i>Quadrula heros</i>	do.....		Occasional.
Long niggerhead.....	<i>Quadrula kirchlandiana</i>	Fair.....		Do.
Maple-leaf.....	<i>Quadrula lachrymosa</i>	Good.....	6,400	Common.
Purple-back.....	<i>Quadrula pustulata</i>	do.....	4,000	Occasional.
Do.....	<i>Quadrula pustulosa</i>	do.....		Do.
Wabash pig-toe.....	<i>Quadrula rubiginosa</i>	do.....	4,200-7,100	Common.
	<i>Quadrula solida</i> ¹	Fair.....		Do.
Long niggerhead.....	<i>Quadrula subrotunda</i>	None.....		Occasional.
Three-ridge.....	<i>Quadrula undulata</i>	Good.....		Common.
Squaw-foot.....	<i>Strophitus edentulus</i>	Fair.....	3,700-6,400	Do.
White head-splitter.....	<i>Symphynota complanata</i>	None.....		Do.
Fluted shell.....	<i>Symphynota costata</i>	Fair.....		Do.
Pistol-grip.....	<i>Tritocoma tuberculata</i>	None.....		Abundant.
	<i>Tritocoma rangiana</i> ¹	Good.....		Common.
Snuffbox.....	<i>Truncella triquetra</i>	Poor.....		Rare.
Lady-finger.....	<i>Unio gibbosus</i>	do.....		Do.
		None.....		Common.

¹ There is no common name in use for this species.

The mucket, *Lampsilis ligamentina*, is the most valuable commercial shell and the predominating species of the headwaters of the Kentucky River. The shell beds, as a rule, average from 90 to 95 per cent of this shell. The following instances are cited to show the

abundance and crowded condition of the mussels in many localities. On a bed in North Fork, Hays Bar, Lee County, a fisherman, standing in water about 2 feet deep, gathered from one spot, without moving his feet, 50 muckets and one lady-finger. A yard further out in the river and under similar conditions he took 81 mussels, enumerated as follows: 77 muckets, 1 pistol-grip, 1 lady-finger, 1 pink heel-splitter, and 1 fluted shell. In the same stream at Doughty Shoals, Breathitt County, a sheller gathered from a spot of sand bottom formed below a large rock 170 mussels, mostly mature muckets. On this latter bed, which had been worked during the season of 1920, there were observed on an area of 1 square foot the extreme tips of 11 large, deeply burrowed muckets.

The nacre of the muckets is usually clear white with very rare brownish stains in the region of the umbone. The shell texture is firm, in some mussels quite hard, with a tendency to be brittle. The mussels are, however, of good quality, though perhaps not equal to that of the same species of more northern streams. The medium and smaller sized shells of this mucket are tolerably uniform in thickness and furnish the best button material. This uniformity of thickness makes it possible to cut excellent tips from the shells. The older shells are much thicker anteriorly and correspondingly heavier.

The mucket appears to be holding its own in the Kentucky River, as a great many of the mussels found were gravid. A large number of juveniles of this species were also encountered, and it appears that natural reproduction of this species is occurring in large amount. The shells of commercial size, number per ton, are as follows: Large size, 3,200; medium, 4,200; and small, 7,100.

The washboard shells are for the most part very large and very heavy shells, with good white nacre and very few stains. The black sand-shells are white naced and of a weight and texture desirable for button manufacture.

The mussel fauna of the Kentucky, as determined principally by the species found in the headwaters and creeks, is practically that of the Ohio. This is especially indicated in the headwaters by the great frequency of the mucket shell. This fact is emphasized also by the occurrence on the upstream beds of the following species: *Truncilla rangiana*, *Obovaria lens*, *Quadrula rubiginosa*, and *Lampisilis luteola*. The only species indicating a faunal connection with the Cumberland drainage is *Alasmidonta minor*, which was taken near the extreme upper limits of the river, not far from the source of the Cumberland. The following mussels, common on many shell beds of the Ohio and more or less large river forms, were not observed in the Kentucky: Niggerhead, *Quadrula eberris*; Ohio River pig-toe, *Q. obliqua*; elephant's ear, *Unio crassidens*; Missouri niggerhead, *Obovaria ellipsis*; and butterfly, *Plagiola securis*. The absence of these shells is perhaps due to their restricted parasitism of fishes that do not ascend the Kentucky River from the Ohio. This is particularly true of the river herring, the host of the niggerhead. It is not known to have been taken in the headwaters of the Kentucky drainage.

The principal fishes observed in the Kentucky River that are important in keeping the mussel beds stocked are the black bass, the sunfish, the drum, the channel and mud catfishes, gars, suckers, redhorse, and minnows.

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PEARLS.

The upper stretches of the Kentucky River are not rich in pearl production. From the good quality of the naere and the fine condition of the predominating mussel, the mucket, together with the general character of the streams, it would appear that the headwaters should yield many valuable gems and an abundance of good baroques. But such is not the case.

These streams, like so many other rivers of the Mississippi Basin, were doubtless visited long ago by the pioneers of the shell industry, the pearl hunters. The output of pearls then was probably so small and the good finds so rare that the hunters left for other fields in anticipation of more remunerative returns. They were interested only in pearls and, though the beds were full of fine mussels, the river was presumably pronounced of no value and was lost sight of for commercial shells.

Only two or three pearling expeditions were learned of and these relate to local pearl hunters working at odd times in some of the larger tributaries of North Fork. The best finds were evidently of only a moderate character. No signs of recent pearl hunting were seen. During the limited shelling seasons of 1919 and 1920 no particularly good finds were reported by those engaged in the mussel-fishing industry. What was found was of small quantity and mediocre quality. The baroques and slugs averaged as low as one-eighth ounce per ton of shells. During the busy shelling season it is hardly profitable for the shuckers to search diligently for slugs and valuable pieces while separating the meats from the shells.

METHODS OF MUSSEL FISHING.

Notwithstanding the fact that the mussel beds of the Kentucky are practically free from snags and serious hangups, the very hard and often uneven surfaces are not suited to such appliances as the crowfoot dredge, the dip net, tongs, or rake. The compactness of the bottom so firmly and securely embeds the mussels that these implements are quite useless to the sheller. The shell-fork, however, can be employed on some of the softer bottoms.

The method of giving the best results and the one generally pursued on the headwaters is that of wading and taking the mussels by hand. This method is, of course, dependent on low stages of the water. A sheller's john boat is usually taken along side; besides affording temporary holding equipment, it is used to deliver the catch to the camps. About the only other equipment necessary is a shell-fork and a bucket when collections are made at some distance from the boat. With the exception of the juvenile shells, the mussels are, as a rule, buried seven-eighths or more of their lengths in the hard bottoms and are removed with difficulty.

SUMMARY.

The Kentucky River is approximately 400 miles long and contains many valuable mussel beds. In the upper reaches of the stream these number about two per mile of channel. They have well defined and characteristic locations easily marked.

The upper Kentucky River is practically an unknown and unworked mussel-bearing stream and contains an abundance of mussels of commercial value, possessing good naere and texture. Of these the mucket constitutes about 90 per cent. This shell has a desirable color, texture, and uniformity of thickness throughout. It appears probable, therefore, that this stream may be particularly useful in the near future as a source of remunerative employment for the mussel fisherman and of desirable raw material for the button manufacturer. The pearls of this river, as a by-product of mussel fishing, are of small consequence, both in the quantity and quality of the pieces found.

The railroad and steamboat shipping facilities of the main river, of North Fork, and of lower Middle Fork are satisfactory. On the upper Middle Fork and on South Fork there are no railroad or steamboat connections and shipments must be handled by small boats. In particularly dry seasons of the year transportation must be made by hauling over rough roads. This is especially true of the South Fork.

The method of shell fishery in the Kentucky River is limited principally to hand picking or to the use of the shell-fork. A stiff bottom in which the mussels bury themselves deeply makes implements commonly used elsewhere in shelling useless in this river.

Of 40 species of mussels observed as indigenous to the river, 22 are commercially usable, but only 9 are of relative importance. This number includes as the most common shells suitable for button manufacture the mucket, the pocketbook, the pimplebacks, the pistol-grip, the long niggerheads, the maple leaf, and the fat mucket.

