

Elk Fork enters the Licking 3.3 miles below West Liberty. The course of this stream is very crooked, but its general direction is somewhat parallel to that of the Licking itself. Its banks are from 8 to 10 feet high, and while mostly of sand, there are occasional portions of rock and shale; the bottoms vary in width from 300 to 1,000 feet. The bed of this stream is generally between 36 and 80 feet wide, and it is full of sand that in many places is quicksand. This sand is constantly in motion, forming bars behind everything that happens to lodge. Elk Fork is over 20 miles long, and its average rise in the six miles measured up from its mouth is 4.6 feet per mile. There is considerable descending navigation on this stream, consisting of coal-barges, rafts (some of which are loaded with coal), and loose logs. The coal-barges, 47 feet long, 10 feet beam, 2½ feet deep, holding between 700 and 800 bushels of coal, are built near the coal-mines and then loaded to await a rise.

Rafts 50 feet long and 12 feet wide are also often loaded with coal, trusting to the chance of getting it to market. Logs are driven on the tributaries of Elk Fork, as well as on the main creek, as its principal tributaries are large enough for this purpose.

There is a large quantity of untouched timber land at the headwaters of this creek and its tributaries.

Middle Fork, Johnson Fork, State Road, and Burning Forks are never used for navigation with boats, but only for rafting and driving logs. Their valleys resemble those of the main river.

In ascending these streams their average rises are found to be as follows: Middle Fork, 7.449 feet per mile; Johnson Fork, 7.371 feet per mile; Burning Fork, 8.849 feet per mile; State Road Fork, 9.501 feet per mile.

The quantity of water flowing in each during the summer is often less than 2 cubic feet per second.

Throughout this region the bottom lands, as a rule, are under cultivation, and the hillsides also, unless their steepness forbids it. The main products are Indian corn, sorghum, wheat, rye, oats, potatoes, and fruits, principally apples, with a few peaches. The raising of live stock also receives a great deal of attention. The greater portion of these products is, however, consumed in the support of the population and of the live stock, the latter being at present the staple article of export; dried apples coming next on the list. Lumbering has also engaged the population for a number of years, and most of the valuable timber close to the river has been cut and marketed, but there yet remain great areas remote from the river which are still untouched by the ax.

The mining of coal for home consumption and for exportation gives employment to some of the population. There is a considerable shipment of cannel coal by wagons that go to the railroad near Mount Sterling for merchandise.

The following tabular statement shows some interesting statistics of Magoffin and Morgan Counties:

	Area in square miles.	Population over 5 years of age.	Inhabitants per square mile.	Taxable capital.	Annual product.			
					Tobacco.	Hay.	Corn.	Wheat.
Magoffin County.....	360	3,700	11	\$76,000	<i>Pounds.</i> 6,417	<i>Tons.</i> 485	<i>Bushels.</i> 258,357	<i>Bushels.</i> 4,380
Morgan County.....	450	5,600	12	\$96,000	12,764	762	376,311	7,169

West Liberty, in Morgan, and Salyersville, in Magoffin County, both places of about 300 inhabitants, are the centers of trade in the Upper Licking Valley. All the merchandise for West Liberty is transported by wagons from the terminus in Menifee County of the narrow-gauge railroad that runs east from Mount Sterling; most of the trade of Salyersville goes to Picketon, on the Big Sandy. No correct statistics of this trade could be obtained, but it is estimated that the annual exports of Morgan County, consisting of feathers, furs, skins, medical herbs, beeswax, &c., amount to about \$100,000. Those of Magoffin County are very nearly the same.

The valley of the Upper Licking, comprising all of Magoffin and the greater part of Morgan County, belongs, geologically, to the productive coal-measures of the Appalachian coal-fields. For lack of means of transportation to a market, its mineral wealth, only sufficiently uncovered to show its enormous proportions, lies waste, save to supply a limited home consumption.

The beds of cannel coal which have been opened at Rush Branch on Elk Fork show a thickness of nearly 5 feet. Bituminous coal is also found in great quantities, but it

is only used for blacksmithing. At West Liberty the mines are only worked for local consumption.

The Calvin coal-bank, a 3-foot vein on a branch of the same name, 4 miles below Salyersville in Magoffin County, produces the best cannel coal thus far found in the Licking Valley. It burns with a bright flame like wood, even in a fire-place without a grate, and it leaves a very small quantity of ashes.

The following tables, taken from the report of Professor Peter, chemist to the Kentucky Geological Survey, give the analysis of some of the coals of Morgan and Magoffin Counties.

MORGAN COUNTY COALS.

No. 1890. *Pierat's cannel coal*.—Collected by A. R. Crandall. A tough, somewhat dull looking coal, breaking with difficulty into thin laminae; contains no apparent pyrites or fibrous coal.

No. 1891. *Cannel coal from Maynhier's bank, Elk Fork of Licking River*.—Layer of cannel coal 2 feet 2 inches thick. No fibrous coal or apparent pyrites.

No. 1892. *Six-foot coal near West Liberty*.—Collected by A. R. Crandall. A soft splint coal, breaking into thin laminae with fibrous coal between, but no apparent pyrites.

Composition of these Morgan County coals, air-dried.

	No. 1890.	No. 1891.	No. 1892.
Specific gravity.....	1.230	1.331	1.353
Hygroscopic moisture.....	2.06	2.30	4.26
Volatile combustible matter.....	49.64	41.60	35.24
Coke.....	48.30	56.10	60.50
Total.....	100.00	100.00	100.00
Total volatile matters.....	51.70	43.90	39.50
Fixed carbon in the coke.....	43.20	44.70	50.10
Ash.....	5.10	11.40	10.40
Total.....	100.00	100.00	100.00
Character of the coke.....	Spongy...	Very dense, spongy.	Dense, spongy.
Color of ash.....	Light-buff gray.	Gray buff...	Nearly white.
Percentage of sulphur.....	0.955	1.271	1.011

Cannel coal No. 1890 is remarkably pure and good; the others contain more than the average quantity of earthy matter, yet are profitable coals.

MORGAN COUNTY COALS.

No. 1878 (a). *Salyersville coal; lower part 14 inches thick; half cannel*.—Collected by A. R. Crandall. A sample partly cannel and partly bright bituminous or splint coal. No apparent fibrous coal or pyrites.

No. 1879. *Salyersville coal; upper part 18 inches thick*.—Collected by A. R. Crandall. A pure looking, pitch-black coal, with very little fibrous coal and no apparent pyrites.

No. 1880. *Coal from Amos Davis's bank on Licking River; bed partly 4 inches thick, with 1 5-inch parting*.—A firm, pitch-black splint coal, with some fibrous coal and fine granular pyrites between its thin laminae.

No. 1881. *Coal from Stacey's coal bank, near the mouth of Johnson's Creek; bed 4 feet thick, without parting*.—Average sample from near the outcrop. A somewhat mixed sample. Mostly bright pitch-black coal, with some little dull and seemingly cannel coal.

No. 1882. *Calvin's cannel coal; bed 3 feet thick. Average sample from the main outcrop*.—Rather a dull looking cannel coal. Portions showing a somewhat fibrous structure; other portions splitting into thin laminae. Has very little fibrous coal and no apparent pyrites.

Composition of the Magoffin County coal, air-dried.

	No. 1878, A.	No. 1879.	No. 1880.	No. 1881.	No. 1882.
Specific gravity.....	1.275	1.292	1.309	1.270	1.235
Hygroscopic moisture.....	1.80	2.70	4.34	3.70	2.30
Volatile combustible matters.....	45.60	38.04	37.36	36.64	51.90
Coke.....	52.60	59.26	58.30	59.66	45.80
Total.....	100.00	100.00	100.00	100.00	100.00
Total volatile matters.....	47.40	40.74	41.70	40.34	54.20
Fixed carbon in the coke.....	43.40	51.62	53.14	54.68	37.56
Ash.....	9.20	7.64	5.16	4.98	8.24
Total.....	100.00	100.00	100.00	100.00	100.00
Character of the coke.....	Dense, spongy.	Light, spongy.	Spongy.	Light, spongy.	Very dense.
Color of the ash.....	Buff gray.	Very light, brownish gray.	Light, purplish gray.	Light buff gray.	Brownish gray.
Percentage of sulphur.....	0.688	1.470	1.357	0.944	1.415

All of these coals are good and most of them very good, containing but a moderate or small portion of ash, and less than the usual quantity of sulphur. The cannel coals, although leaving more ash than the others, would doubtless produce fully as much heat in equal weight of the coals, because of their larger proportions of hydro-carbons; it being a well-established fact that hydrogen will give out three times as much heat as carbon when they are burned in equal weights.

Below McClure's mill the Licking River enters the conglomerate rocks near the base of the coal-measures, and it is these rocks, in connection with the underlying Subcarboniferous limestones, that form the gorge of the Licking River, which is known as "The Narrows." Here the river is imbedded between vertical cliffs, hundreds of feet high, shaded by evergreens, spruce-pines, laurel, and ivy, which combine to make this region wild and picturesque.

On the Subcarboniferous rock as a base rests the excellent iron ore (*limonite*) on which the famous Red River iron industry is based.

After descending through "The Narrows," the river enters the beds of shale and sandstone of the "Waverly" section, which are easily abraded. As a consequence the river basin is considerably expanded. The average width of basin, which was less than 20 miles, is considerably increased, and when in its course the river reaches the lower black shale beds of the Devonian age, a width of 40 miles is attained. The Licking now receives tributaries of considerable magnitude, such as the North Fork, Beaver Creek, Salt Lick, and Triplet Creek. A little above Slate Creek, in Bath County, the river enters the limestone of the Silurian system, in which it remains to its mouth. Slate Creek gives a perceptible addition to the volume of water in the Licking.

On the tops of the hills, 4 miles from Owingsville, in Bath County, about 200 feet above the waters of Slate Creek, are found the so-called "Preston iron-ore banks," covered with a few feet of soil, and associated with the Clinton limestone of the Silurian system. These beds extend over a surface of nearly 150 acres, and have a maximum thickness of 14 feet. It is said that this oolitic, highly fossiliferous ore was worked in the Slate furnace from 1791 to 1838.

On the headwaters of Slate Creek there are deposits of limonite associated with the Subcarboniferous limestone. It is also exposed on the waters of Cane Creek, where it was worked by the Cane Creek furnace; in Beaver Creek, where it was worked by the Beaver Creek furnace; and in Clear Creek, where it was worked by the Bath County furnace. All of these streams are tributaries of the Licking.

Iron ores of Bath and Menifee Counties.

[From Kentucky Geological Survey, Vol. IV, New Series.]

	From Pergam Bank, Bath Furnace, Clear Creek, Bath County, collected by P. N. Moore.	Bank near head of Clear Creek, Bath Furnace.	From Richardson's Bank, Bath Furnace, Bath County.	From head of Ratcliff Branch, Beaver Creek, Menifee County.
Iron, peroxide.....	65.310	59.621	66.320	54.750
Iron, carbonate.....				
Alumina.....	11.947	12.370	12.532	14.517
Lime, carbonate.....	0.730	0.520	A trace.	A trace.
Magnesia.....	0.140	0.144	0.173	0.047
Phosphoric acid.....	0.825	0.709	0.709	0.697
Sulphuric acid.....	A trace.	A trace.	A trace.	A trace.
Combined water.....	11.000	10.400	9.580	8.600
Silica and insoluble silicates.....	9.580	15.830	9.720	20.830
Total.....	99.532	99.574	99.043	99.441
Continued:				
Metallic iron.....	44.570	41.735	46.440	38.750
Phosphorus.....	0.360	0.309	0.309	0.304
Sulphur.....				
Silica.....	9.580	13.060	9.060	19.307

Preston Ore Banks.—Iron ores.

[From Kentucky Geological Survey, Vol. IV, New Series.]

	From Block House Hill. Sample from all ore exposed. Collected by P. N. Moore.	From Block House Hill. Sample from the upper part of the bed.	From the Howard Hill.
Iron, peroxide.....	76.077	69.728	70.060
Alumina.....	2.592	8.642	4.540
Manganese.....	0.430		
Lime, carbonate.....	0.130	0.170	0.040
Magnesia.....	0.281	0.045	0.021
Phosphoric acid.....	0.731	1.154	1.620
Sulphuric acid.....	0.030	0.134	0.031
Silica and insoluble silicates.....	8.180	7.930	11.530
Combined water.....	12.300	12.650	12.300
Total.....	100.751	100.453	100.142
Continued:			
Metallic iron.....	53.254	48.809	49.042
Phosphorus.....	0.319	0.504	0.707
Sulphur.....	0.011	0.053	0.012

"It will be seen by the above analysis that these ores are much richer in iron than is generally supposed. The percentage of phosphorus is also large, as was indicated by the character of the iron made from the ore."

The navigation of the Licking was never important. Coal-barges, 60 feet long and 15 feet wide, intended to draw 4 feet of water when loaded, are built near the coal-mines. They are filled with from 2,500 to 3,000 bushels of coal and then held in readiness to float down on the first rise. Some coal is transported on rafts about 60 feet

long and 13 feet wide. If these boats and rafts succeed in struggling past the sharp bends and through "The Narrows," they find a ready sale in the lower counties for both coal and lumber. Most of the shipping of lumber is done by "driving"; that is, by letting the logs float loosely with the current, and following them down so as to set afloat any that may get stranded. At the town of Boston, about 25 miles from the mouth of the river, there are heavy booms for the purpose of catching and holding the floating logs. Navigation of any kind, however, is only possible when a freshet occurs, and then the river for miles is covered with drifting logs.

The chief hinderance to easy navigation on the Upper Licking, besides the general prevalence of low-water, is the difficulty of passing the sharp bends with their swift currents. This is especially so in the 15 miles known as "The Narrows." As a rule both boatmen and raftsmen tie up until morning, if night should overtake them before they get through. During a freshet the river is filled from bank to bank with floating logs, that hinder the movements of boats and sometimes break up rafts and sink boats that are tied to the shore during the night.

Rises in the river are seldom of long duration, and it often happens that the water outruns boats and rafts while they are tied up waiting for daylight.

There are many large isolated rocks in "The Narrows" that much obstruct navigation.

The chief complaint of navigators is against the privileges exercised by the Licking River Lumber and Mining Company, whose charter from the State of Kentucky gives it the privilege of free and unobstructed passage for floating logs, the practical effect of which is to prevent anybody else from successfully navigating the river. To understand the full authority granted by this charter, a copy of its essential paragraphs is annexed and marked Appendix C.

There is no practical improvement of any kind that can advantageously be made on the upper part of the Licking River as long as the lower portion of it remains in its unnavigable condition.

The difficulties of securing a good practical navigation on the Licking are due to the following causes:

1. The small quantity of water in the river during the summer and fall.
2. The steepness of its slope.
3. The lowness of the banks.
4. The rights of the "Licking River Lumber and Mining Company."

It is doubtless true that, were a slackwater navigation established, coal from the upper and iron ore from the middle portion of that river could find an outlet, and it is believed that the coal would find a limited market in the interior of the State along the river itself, but it is doubtful if it could compete successfully in the Cincinnati coal market. The iron ore, however, would always be in demand.

The total rise to be overcome between Cincinnati and Salyersville is 409 feet; the distance measured by river between these points is 275 miles, while the air-line distance is only about 125 miles.

It may not be considered improper to refer here to a kind of improvement in use in some parts of Europe on streams where the water supply is deficient and navigation is principally down stream. The improvement consists of a dam with a slide, but without a lock. The slide is a wooden structure of such an inclination that descending boats will not acquire too great a velocity. The slope is usually about 1 foot in 50. Boats using the slide are not water-borne, but a small quantity of water flows down, which acts as a lubricator. To help the loaded craft over the crown of the dam, and to drag the empty returning ones up, some convenient power is employed.

Comparing this arrangement with the lock and dam, it recommends itself on account of the small quantity of water necessary and the simplicity and cheapness of construction and maintenance. These slides are adapted to dams of any height.

An improvement of this kind seems to deserve some investigation and experimenting as to the practicability of using it on such a stream as the Licking.

On the "Salz Kammergut," the salt domain of the Crown of Austria, such a navigation is employed to carry salt to market.

During the years 1836 and 1837 the State of Kentucky, contemplating the improvement of the Licking River by locks and dams, ordered surveys to be made from its mouth to West Liberty. This was done, and in a copy of the accompanying report to the Hon. William Owsley, president of the board of internal improvements, by Sylvester Welch, chief engineer of Kentucky, which is annexed to this report as Appendix A, are given the estimates of the cost, lifts, &c., of the proposed locks and dams from the mouth of the river to the Lower Blue Licks, and also a further estimate from there to West Liberty. In the year 1837, the survey was continued to the latter place and reported upon. A copy of this report is also annexed as Appendix B.*

* It was supposed that the maps to which this report alluded could be found. A diligent search for them in the archives of the State proved of no avail. It is generally believed that these maps were consumed by the fire which destroyed the archives of the State at Frankfort in the year 1869.

It was arranged to overcome the rise by 21 locks and dams. The total lift is 310 feet, and the distance is 231 miles. The locations and lifts of each lock are shown by the following table, which is copied from Collin's History of the State of Kentucky:

No. of lock and dam.	Miles from mouth.	Locality.	Lift of lock.	Height of dam.	Length of pool.	Estimated cost.
			Feet.	Feet.	Miles.	
1	3	Three-Mile Ripple.....	17½	22	3	\$94,347
2	6	Six-Mile Ripple.....	18	26	16½	94,670
3	22½	Dutchman's Ripple.....	16	24	11½	74,166
4	34½	Willow Ripple.....	17	27	9½	81,225
5	44	Hendrick's Ripple.....	16	25	7½	80,962
6	51½	Falmouth.....	16	24	16	82,251
7	67½	Buoy's Fish Dam.....	15½	25	10½	78,320
8	77½	Claysville.....	15	25	13½	77,310
9	91½	Panther Creek Ripple.....	16	25	15½	80,730
10	106½	Isle below Fleming Creek.....	16½	23	20	84,655
11	127½	Andrew's Mill.....	15	22	13½	79,815
12	140½	Ringo's Mill.....	15½	22	11	76,035
13	151½	Atchison's Ripple.....	12	19	11½	69,360
14	163½	Ile's Mill.....	9	17	6½	64,235
15	169½	Adams's Ripple.....	13	20	6½	64,350
16	176	Coug's Shoal.....	9	16	6	56,675
17	182	Gill's Mill.....	9	17	9½	61,465
18	191½	Wilson's Ripple.....	15½	22	12½	65,813
19	.....	Ellington's Ripple.....	16	23	.....	.....
20	212	Blackwater.....	17	24	.....	.....
21	.....	Flatwood's Ripple.....	18	25	.....	.....

The total estimated cost of continuing the improvement to West Liberty was \$1,826,481. In October, 1837, the first five locks and dams, which would bring slack-water up to Falmouth, were put under contract.

It was expected, when the locks were begun, that stone for the two lower ones would be obtained from quarries along the Ohio River, and that stone for the others could be quarried near each lock. The contractors for the two lower locks opened quarries near Portsmouth, on the Ohio River. The contractors for locks Nos. 3 and 4 opened several quarries in the vicinity of the lock-sites, but failed to obtain stones of a size and quality suitable for building lock-walls. The contractor for lock No. 4 failed to execute his contract. It was relet with the modification of admitting the use of smaller stones in part of the walls, the face-stone, however, to be brought from the Ohio River.

The contractor of lock No. 5 died after having opened quarries and done some work on the lock-pit. The only work of great value done, however, was that a channel 100 feet wide and about 1,250 feet long was cut through the rock bar in the Ohio River at the mouth of Licking. This channel, excavated out of the limestone, was deep enough to permit steamboats to enter the Licking as long as they could navigate the Ohio. Its cost was \$5,383.47.

The plan of building the locks 130 feet long and 25 feet wide was abandoned in favor of locks 150 feet long between the gates and 31 feet wide in the chamber. This alteration raised the estimated cost to \$2,036,000. Stone 20 inches thick was obtained from a quarry near lock No. 4 and used for the face of the walls.

Locks Nos. 7 and 8 were put under contract in May, 1839. The contractors, after many disappointments in opening quarries, succeeded in finding good building stone on the bank of the river, 5 miles above lock No. 8.

The hydraulic lime used in the locks was obtained partly from Louisville, and was partly manufactured at the locks with the aid of horse-mills, locks Nos. 3, 4, and 5 each having one.

Stone of excellent quality and desirable size is reported as having been found on the banks of the river in Fleming County, and described as follows: "They are immediately along the bluffs of the river, of easy access; great abundance, never to be exhausted, and equal in quality to any in the country."

During the year 1840 the work on this river had to be suspended for want of funds to pay the contractors.

In the month of October, 1842, the president of the board, accompanied by Messrs. S. Welch and T. S. Bush, visited the works upon the Licking River, to make examinations and estimates for final settlements with the contractors. The contractors afterwards met at Frankfort, where a settlement was effected and the work was stopped.

This ended the improvement of the Licking River. Since that time nothing has been added to the work; on the contrary, except lock No. 3, which is pretty well pre-