

The record closes with December 13, with 15 feet water at Pittsburgh and 8 feet 8 inches at Oil City. The weather indications are such that it is scarcely probable the Allegheny for the remainder of the year will at either place fall as low as 3 feet. The Oil City record can only be obtained from about July, 1877, so that this is the first complete year's record which can be furnished. The navigable season at Pittsburgh was better than ordinary during this year. The Upper Allegheny was excessively low in October, but on the whole the figures represent, I believe, an average year.

We learn from the record that the Allegheny during 1878 was navigable to Oil City for vessels drawing 3 feet or over only 119 days, or about 4 months. The river is apt to be frozen up at Oil City in navigable stages at least 1 month each year, which would leave only 3 months of fair navigable depth to that point. Below the Clarion and Red Bank rivers, which are important tributaries, I feel satisfied the 3-foot stage would continue one month longer than at Oil City.

The construction of the dams proposed will increase the depth in the low-water channel 6 or 7 inches, and with the removal of the rocks besides boats can run safely at a 2-foot stage. There will thus be added at the least calculation 6 weeks, possibly 2 months, to the season of navigation for steamers of considerable size to Oil City, while to Parker's Landing, Brady's Bend, &c., much more of an improvement will be effected.

The dams can be so located as to aid rather than endanger rafting. Rafts, when late in reaching the main stream, are compelled to follow the low-water channel, and would experience the same benefits from its improvement as other craft. At the stages as now, with the unimproved river, when they pass over low bars, they would also clear the dams, which would be built no higher. These rafts navigate between bridge piers placed only 158 feet apart, while the dams will always leave an opening of at least 250 feet. In the case of rapids requiring more contraction than this, the improvement could be confined to the removal of the rocks. I can see, therefore, no grounds to base any opposition to this method of making a sluice navigation in the Allegheny. Several raftsmen with whom I conversed approved of the plan. One of them, whose raft of boards was lodged on the low rocks in the channel as we passed along, was busily employed with a gang of men taking it apart and reconstructing it below; an operation involving considerable time and expense.

The average length of the dams would be about 500 feet. In nearly all cases they would be built in quite shallow water and on a firm foundation. They would not probably average more than 4 feet in height. The estimate of their cost is based on the assumption that they would be built of cribs filled with stone, such as the dam recently constructed, under your direction, by Mr. I. V. Hoag, at White's Ripple, in the Ohio. It is a plan calculated to withstand the action of the ice much better than ordinary riprap dikes.

Approximate estimate of cost of improvement of the Allegheny River between Franklin and Freeport, 93 miles.

Wing-dams, 15; average length, 500 feet—7,500 feet, at \$5.....	\$37,500
Removal of rocks in the channel, 33 places—3,300 cubic yards, at \$2.50	8,250
Blasting dangerous shore rocks, &c.....	1,000
	46,750
Add 10 per cent. for engineering and contingencies	4,675
Total	51,425

I beg leave to refer you to the accompanying memoranda or description of the river for detailed notices of the places which require improvement:

MEMORANDA OF RECONNAISSANCE OF THE ALLEGHENY RIVER FROM FRANKLIN, PA., TO FREEPORT, PA.

Franklin, Pa., October 1, 1878.—The stage of the river is called 10 inches by the signal observer at Oil City, 9 miles above this place. I am informed that it has yet to fall about 5 inches more before it will reach its lowest stage. We roughly gaged French Creek, and found the discharge to be 42,500 cubic feet per minute. French Creek is one of the most important tributaries of the Allegheny River. There is water enough to run a large mill which is located 500 feet above its mouth, while more or less water is constantly wasting over the dam. This dam is provided with a lock for the passage of moderate-sized boats, such as keel-boats and flats, which are sent to Pittsburgh, often carrying produce from the French Creek Valley. It was upon this stream that Fort Le Boeuf, within 20 miles of Lake Erie, was situated. This was the favorite post of the French and other early traders on the portage between the lakes and the Ohio Valley.

Franklin, at the mouth of French Creek, is the county seat of Venango County, and is a handsome town of 6,500 inhabitants; it is one of the emporiums of the oil regions, but has a more substantial basis than most of these places. The mouth of French Creek marks the southernmost limit of the heavy or lubricating oil belt. Immediately over the mouth of the creek and 500 feet below the mill, the Lake Shore and Michigan Southern Railroad crosses upon an iron bridge of four spans (entire length 455 feet), elevated in the clear about 30 feet above the surface of low-water. French Creek enters the Allegheny over a ripple. The channel of the Allegheny, opposite its mouth, is nearer the left bank. One-quarter of a mile below the mouth of French Creek we passed under the Franklin Bridge.

Franklin Bridge.—An open wagon-bridge across the Allegheny, through truss, wood and iron. Length between abutments, 711 feet; four spans, 175 feet each; height in clear above low-water, 31½ feet; width of roadway, 18 feet; total width, including footwalk, 26 feet. The channel-way under either of the central spans is good. Half a mile below French Creek we encounter Porter's Ripple.

Porter's Ripple.—Depth at low-water, 2 feet; length, 1,320 feet; fall (by survey of 1828), 1.6 feet. The channel through it is easy, and no improvement appears necessary. A large rock on the right of the channel just below the ripple should be removed (say 2 cubic yards to be blasted). Just at the head of the bend to the left we stopped for the night. This is also the head of Blue or Washington Rock Ripple. [A conspicuous rock at the water's edge on the right gives the name.]

Blue Rock Ripple, 1.1 mile below French Creek.—The old map of 1828 gives a cross-section of the river here at the old ferry landing. We identified the location and duplicated the section. The head of the rapids has apparently moved down, and the river is 1 foot deeper. Depth on shoal, 2 feet; length, 1,200 feet; fall, 8 inches. A small bar opposite Blue Rock, shown on the map of 1828, has disappeared. Other changes are observable. The place is not troublesome to the raftsmen and others who navigate the river, and no improvement appears necessary. Thence good water 1 mile, through a pool 8 feet deep, to Petticoat Ripple.

Petticoat Ripple, 2.2 miles below French Creek.—Depth, 1.3 feet; length, 730 feet; fall, 2.39 feet. Channel at upper end is only 60 feet wide, with a rock in the center which should be removed in case of improvement for low-water navigation. Otherwise no further improvement seems necessary. Thence half a mile of good water to Hoover Island.

Hoover Island.—*Upper Ripple* begins 2.7 miles below French Creek. Depth, 1.2 feet; length, 500 feet; fall, 2 feet. Thence a pool 1,000 feet long conducts to the Lower Ripple, 3.2 miles from French Creek. Depth, 1.2 feet; length, 500 feet; fall, 1.55 feet. The old map shows the island as connected with the left shore. There is now a chute carrying a little water down that side. A gravel bar has formed between the island and the right bank, opposite the head of the island, while 400 feet in length of the head of the latter has washed off, leaving a head bar. The uppermost ripple is quite rapid, but no improvement seems necessary. The lower one is not so swift, nor does it require improvement. Thence good water for half a mile to Porter's Island Ripple.

Porter's Island Ripple, 4 miles below French Creek.—Depth, 2.2 feet; length, 575 feet; fall, 1.20 feet. The channel is here nearly equally divided by an island; best water down the right chute. There is a rock to be removed; no other improvement will probably be required. Since 1828, 600 feet of the head of the island has been washed away. The old map shows a continuous rapid from the head of this rapid for 1 mile, whereas the rapid now ends 300 feet above the foot of the island; its present length is as stated above. Thence good water (10 feet and over) for 0.8 mile to Porter's Run, which enters from the left, but does not appear on the old map.

Porter's Run Ripple, 4.9 miles below French Creek.—Depth, 2.2 feet; length, 700 feet; fall, 1.00 foot. Large bar here in mid-river covered at a moderate stage. Channel to the right of the bar. Several large rocks in this ripple should be removed. A considerable volume of water passes down to the left of the bar, but there is a sufficient depth in the main channel. Thence for half a mile good water to East Sandy Creek Ripple.

East Sandy Creek Ripple, 5.4 miles below French Creek (called also Six-Mile Run).—Least depth, 1 foot; length of ripple, 3,400 feet; fall, 3.25 feet. Channel at upper end is in mid-river, but below the mouth of the creek it sets in close to the left shore to avoid rocks; thence back toward mid-river. The channel could be straightened, and the depth improved somewhat by the removal of some of these rocks, particularly those at the upper end, which show out of water at the lowest stage. Thence good water half a mile through Smith's "Eddy" to Foster Island.

Foster Island Ripple, 6.8 miles below French Creek.—Least depth, 1.2 feet; length, 7,000 feet; fall, 7.19 feet. The steepest slope is near the lower end, where in a length of 2,000 feet there is a fall of 2.98 feet. The whole ripple is a continuous stretch of bad river. Ten years ago the channel was to the right of Foster Island, but that side is now almost dry. At the upper end of the present channel the width is scarcely more than 200 feet, and being so narrow the depth is good, though there are several rocks which should be removed. After passing the island the water escapes between bars

on the right into the back channel, which is separated from the navigable channel by a nearly continuous bar. The water in this back channel or pool is nearly level, while in the navigable channel it continues to descend; thence soon results a difference of level which at the lower end is as much as 1½ feet. In consequence of this great difference the surplus water of the back channel returns to the main channel in little cascades over the reef. The removal of a number of rocks and bowlders would improve the channel. The question of the utility of a continuous dike from the foot of island, in order to confine the water in one body, can be deferred for the present. Foster Island is regarded as a troublesome point by steamboatmen. Thence good water 1 mile to Big Sandy Creek Ripple.

Big Sandy Creek Ripple, 9.5 miles below French Creek.—Least depth, 2.2 feet; length, 600 feet; fall, 0.92 foot. This ripple is comparatively gentle; there are a few rocks to the left of the channel, but apparently no work of improvement is required. Thence good water nearly 1 mile to Brandon's Ripple.

Brandon's Ripple, 10.4 miles below French Creek.—Depth, 1.3 feet; length, 800 feet; fall, 1.88 feet. There is a rock near channel on the right, otherwise the ripple is easy and no improvement is necessary. Thence good water ¼ mile to Saint George's Ripple.

Saint George's Ripple, 11.2 miles below French Creek.—Depth, 1.3 feet; length, 1,700 feet; fall, 3.12 feet. This ripple begins a short distance above the head of Saint George's Island. The channel takes down the right chute of the island. There are a number of rocks on the right side of the channel which could be removed to advantage, though they are not particularly dangerous. Thence 1 mile of good water to Stein's Island Ripple.

Stein's Island Ripple, 12.3 miles below French Creek.—Depth, 3 feet; the ripple is scarcely appreciable, and it causes no trouble. Stein's Island is covered at a five-foot stage; in fact, it is now only a bar. The channel is down the right-hand chute. Thence good water to Charlie's Oven Ripple.

Charlie's Oven Ripple, 13.7 miles below French Creek.—Depth, 0.8 foot; length, 1,600 feet; fall, 3.38 feet. This is a bad shoal. The channel passes to the right of several bars. The place could be improved at once by closing the outlets through these bars by means of a long wing-dam from the left shore. But since the channel at rafting stages is in the bend, the heights of dams must not exceed those of the bars over which rafts must pass. Thence good water through Williamson's "Eddy" 1 mile to Dennis Run Ripple.

Dennis Run Ripple, 15.1 miles below French Creek.—Depth, 1.8 feet. This is a very gentle ripple, the only trouble being one rock to the left at the lower end. Thence good water 1.5 miles through Malony's "Eddy" to Scrub Grass Creek Ripple, passing on the way Scrub Grass Station on the Allegheny Valley Railroad. This railroad follows the river closely all the way along on the left bank. At Scrub Grass the United Pipe Line have one of their largest pumping stations, the engine being supplied with natural gas for fuel. Scrub Grass is the trading point for the once celebrated Bullion Run oil region, now comparatively insignificant. The Allegheny is spanned here by a thorough Howe truss bridge of wood, built last year for a railroad 4 miles long which extends up Bullion Run. The railroad is already abandoned, and the railroad bridge has been converted into a highway-bridge. Its total length is 471 feet, divided into three spans of 157 feet each. The clear height of lower chord above low-water is only 22.7 feet. The piers are timber cribs, but well constructed. This bridge is about 5 feet lower than any other bridge on the river, and it is a serious obstruction to navigation. It should at least be raised as high as the others. Just above the bridge a conduit oil pipe is suspended over the river at a height of about 40 feet above the low-water surface.

Scrub Grass Creek Ripple, 16.6 miles below French Creek.—Depth, 1.00 foot; length, 3,400 feet; fall, 4.77 feet. Half way down the ripple the fall in 150 feet is 0.91 foot. A short wing-dam from the foot of the island to a small central bar shown on map, would be advantageous, and a number of rocks and bowlders, none of which are large, should be removed. Thence one mile of good water to Sister's Bars Ripple.

Sister's Bars Ripple, 18.8 miles below French Creek.—This place is a widespread shoal with but little fall. It would be advisable to extend a low wing-dam from each side to maintain the channel in the middle of the river. It is a place which at higher stages in the river probably causes no complaint, but as it appears in "dead low" water it is remarkably shoal. Thence good water half a mile to Jacob's Bars Ripple.

Jacob's Bars Ripple, 18.8 miles below French Creek.—Depth, 2.00 feet; length, 600 feet; fall, 1.67 feet; velocity, 3.4 miles per hour. I have noticed that the velocity of the rapids at this extremely low stage in the river bears less relation to the volume, length, and descent than it does to the character of the bottom over which it flows. Of course at higher stages in the river the impediments in the way or the resistance of the bottom to the current is relatively diminished until with great depths the character of the bottom can be safely neglected as an element for calculation. Jacob's Bars will probably require no improvement, though the channel is somewhat crooked. The removal of projecting points may at some future time prove necessary. Thence one-fourth of a mile of good water to Robert's Run Ripple.

Robert's Run Ripple, 19.2 miles below French Creek.—Depth, 2.5 feet; length, 350 feet; fall, 0.71 foot. The river is here confined in one body, and the channel is straight and easy, no improvement being required. This place presenting favorable conditions for gauging the stream, we measured it and found the discharge to be 143,900 cubic feet per minute. We only employed surface floats, but selected a point below the shoalest portion, where the depth of the section was greater and the average velocity less. It is stated that the Allegheny, near Pittsburgh, discharges as little as 80,000 cubic feet per minute during the lowest stages. It had here to fall about 3 inches to its lowest marks, which might possibly reduce the discharge by 20,000 cubic feet per minute, making it 123,000 cubic feet per minute. Granting that 80,000 cubic feet per minute is the least discharge of the river at Pittsburgh, our measurement would appear to show that at times the river may dwindle in volume as it descends. I am prepared to believe that it may have a somewhat diminished discharge farther down at odd seasons, when the larger tributaries are nearly dry, as we found them; but yet I am not prepared to believe that the loss by evaporation could be so great a proportion of the whole as these figures would seem to indicate. Possibly more exact measurements would increase the discharge at Pittsburgh and diminish that at Robert's Run, so as to preserve a more natural relation between the two. Thence good water three-tenths of a mile to Falling Spring Rapid.

Falling Spring Rapid, 19.5 miles from French Creek.—Depth, 1.8 feet; length, 500 feet; fall, 1.62 feet; velocity, 3 miles per hour. There is no trouble here and no improvement is required. A large high shore-bar on the left probably calls for some skill in raftsmen to avoid it in very high water. On the right, at the foot of the rapid, Falling Spring tumbles down from the low shale bluff in a delicate cascade from the height of 30 feet. The top of the cliff above the falls is fringed with scrubby pine. Thence, good water 3.4 miles to Elephant Rapid.

Elephant Rapid, 22.9 miles below French Creek.—Depth, 1.5 feet; length, 1,100 feet; fall, 3.66 feet. This place has changed greatly since 1828. The old map shows the river as clear of bars; now there are three large bars, one extending down a long distance from the left bank and terminating in mid-river. The other two, farther down, are detached bars, between which the channel passes. A material improvement could be effected by closing the right-hand chute by means of a low dam. Care should be taken not to build high dams as the best low-water channel is evidently not the best at high-water, as at high stages the current usually takes into the bends, and in this case the rafting channel is through the chute proposed to be closed. At this place, as in a number of others, which apparently show a sufficient low-water depth, some improvement is suggested in order, as much as anything else, to afford more room for maneuvering in swift water. Thence good water 1 mile to Shields Run Ripple.

Shields Run Ripple, 24 miles below French Creek.—Depth, 2 feet; a very gentle ripple and no improvement required. The channel is in mid-river, with a half-moon shaped shore-bar to the right. Thence good water 1.4 miles through Craig's "Eddy" (the name given to pools in the Allegheny) to Ewalt's Island Ripple.

Ewalt's Island Ripple, 25.4 miles below French Creek.—Depth, 1.5 feet; length, 1,975 feet; fall, 2.54 feet. The channel is to the left of the island. A large rock to the left near the lower end of the ripple should be removed; no other improvement seems to be required. Thence good water 1.5 miles around "Stover's Bend," through Gates "Eddy," to a ripple (name not obtained).

Ripple, 27.3 miles below French Creek.—Depth, 2.5 feet; fall scarcely appreciable. With the exception of the removal of one dangerous rock, no improvement is necessary. Thence good water ½ a mile to Black's Ripple.

Black's Ripple, 27.9 miles below French Creek.—Depth, 1.5 feet; length, 2,100 feet; fall, 4.41 feet. In 800 feet, near the lower end, the river falls 2.3 feet. On the left bank there is now a bar 2,600 feet long. At its lower end, for 300 feet, it is high; covered only at a 10-foot stage. The map of 1828 shows an island, 1,500 feet long, located upon the upper end of this bar. Several rocks in the channel should be removed; otherwise there is no difficulty here. Thence good water 1 mile through Beal's Eddy to Patterson's Falls.

Patterson's Falls, 29.5 miles below French Creek.—Depth, 1 foot; length, 850 feet; with a total fall of 3.9 feet. In the first 200 feet the descent is 1.21 feet, or at the rate of 32 feet per mile. This is accounted one of the worst places on the Allegheny River. At this extreme low stage, the depth being only 1 foot, the velocity of the current was only 3½ miles per hour. At high stages it is said to be much swifter, and steamboats are frequently compelled to cordel through the rapid. At the head there is a small semicircular shore-bar on the right, around which the channel runs towards the right bank. To the left of the rapid there is an extensive high rocky bar projecting from the left bank a distance of several hundred yards. As neither of these bars appear to infringe on navigable limits, I am compelled to think the difficulty here is solely on account of the current. It is difficult to devise any improvement without first witnessing the action of the water at high stages. All the water is already confined to a width of about 250 feet, which is about as narrow as navigation will per-

mit. The removal of some of the bottom might be permitted if it proves not to injuriously affect the ripple next above. Just below Patterson's Falls, and separated by a short intervening pool, the channel is divided by several quite small, rocky, and detached bars. The bottom is smooth, solid rock, and these lumps or bars have possibly been raised by ice gorges which on the Allegheny are at times quite terrific. It is to their action that we must refer the chief part of such material changes as have occurred in this river since 1828. I have myself seen the river frozen up solid with ice 30 inches thick. From below Patterson's Falls the river is of good depth for about 0.6 of a mile, to the head of McGinnis Rapid, which is the beginning of what is better known as "Nicholson's Eddy," a name which has been applied facetiously to one of the longest and worst rapids in the Allegheny.

McGinnis Rapid, "Nicholson's Eddy," 30.8 miles below French Creek.—Least depth, 0.8 foot; length, 6,900 feet; fall, 11.23 feet. This is a connected series of rapids. The least depth was at the entrance to the right of the central bar now just dry (a raft of sawed lumber was beached upon it). The channel is down the right shore over very rough bottom. The left half of the river is separated by the reef or central bar just mentioned from the right side, and for the first half-mile has less fall (a case similar to Foster Island Rapids). Consequently the water which takes that side re-enters below through lateral issues. A wing-dam at the head from the left shore to the reef mentioned above, and the removal of numerous stones and boulders, none very large, would materially improve the place. Nothing, probably, but a slackwater improvement would decrease the force of the current, which at some stages is exceedingly rapid in this mile of the river. It is quite impossible to reconcile the distances as shown by the map and profile of the survey of 1828. The map appears correct and agrees well with the railroad distances. But in the case of some rapids, and particularly at this place, as shown on the profile, I cannot identify them. The levels here given are therefore our own. Good water thence to Emlenton Bridge and past it to Ritchie's Run Ripple.

Emlenton Bridge, 33.6 miles below French Creek.—A covered, wooden-arch bridge of two spans, with a total length of 456 feet; the total width, 23 feet, and there are no foot-walks. The channel span to the right is 228 feet wide, and is elevated 34 feet in the clear above the surface of low-water. Emlenton, on the left bank, has a population of about 1,000. The Emlenton and Shipperville Narrow Gauge Railroad leaves this point and runs eastward to the Clarion County oil regions.

Ritchie's Run Ripple, 34.4 miles below French Creek.—October 9, left Emlenton 10 a. m. From the bridge to Ritchie's Run there is considerable current, but no defined ripple. A short distance above the run one or two rocks in the channel could be lifted by a crane. The bottom all along is rough, composed of large fragments of rocks, the depths varying from 3 to 6 feet and over. The ripple has 2 feet depth; length, 700 feet; fall, 1.20 feet. The removal of 6 rocks, say each a cubic yard, would make the channel easy and safe. Lowrie Run enters half a mile below the ripple. The left shore is rocky, as usual, but the shore on the right below this run is muddy, being the first soft or muddy shore bar that we have seen; several snags were lodged in it, but entirely out of the way. Water continues good to Cumming's Trunk Ripple.

Cumming's Trunk Ripple, 35.6 miles below French Creek.—Depth, 2 feet; length, 1,100 feet; fall, 1.49 feet. Not a bad place, though the removal of a few stones would improve it. Thence the channel is deep through Stump Creek Eddy to the first ripple above the mouth of the Clarion River. At 37.3 miles we passed under *Foxburg Bridge*; length, 522 feet, with two spans, each 261 feet; roadway, 21 feet; foot-walk, 8 feet wide. The channel is under the left span. The bridge is composed of iron bow-string girders, and its height in the clear above low-water is 28.3 feet. Foxburg, on the left, is another oil town with a population of about 500. The Foxburg and Clarion Narrow Gauge Railroad leaves this point for the "regions." It ascends the hills by means of a "switch-back," first up the river, thence back, and passing south of the town near the brow of the hill, turns up the Clarion River Valley.

Ripple above mouth of Clarion River, 38.3 miles below French Creek.—An island divides the river here, which is unusually wide; 1,035 feet by our cross section. The entire length of the ripple, or rather of the series, is 2,500 feet, with a fall of 2.8 feet, and a depth of 0.7 foot at the lower end. Just above the Clarion our boat rubbed the bottom. The place could be improved by picking out some small stones and by constructing a wing-dam from the right shore to the head of the island. (There are several reliable oil-wells on the island.)

Ripple below mouth of Clarion, 38.9 miles below French Creek.—Depth, 1.5 feet; length, 700 feet; fall, 1.78. This ripple is separated from the one above by a short shallow pool. It could be somewhat improved by the removal of a few rocks. A long dike from the foot of the island, in case the upper dam was built, would confine all the water in the channel as far down as the Parker Bridge. Here is another example of the surface of water on the two halves of the river flowing in planes differing a foot or more in height. From the foot of this rapid the current is strong, but the depth is good to the Parker City Bridge.

The Clarion River enters from the left at 38.9 miles below French Creek. It is crossed at its mouth by the Allegheny Valley Railroad, on a through covered wooden bridge with single track. The total length is 328 feet, with two spans, one of 186 and the other 142 feet. The height in the clear above low-water surface of the Clarion is 33 feet. The basin of the Clarion has an area of about 900 square miles, or about as large as that of French Creek, but at this period the latter is discharging possibly twenty times as much water. It was so perfectly "dead" in the pool under the bridge that I could not gauge it there, but I risk the opinion from the appearance which its thin yellowish streak made in the Allegheny. Its volume I would judge at this time was about as much as Big Sandy Creek, which we gauged and found to discharge about 1,100 cubic feet per minute. I was not aware before that the Clarion dwindled to such small proportions in periods of drought. During rainy seasons, the Clarion, next to the Kiskiminetas, is probably the largest affluent of the Allegheny River. Great quantities of pine lumber are annually floated out of the river. At the time we passed a number of rafts were tied up in it above the railroad bridge, waiting for a rise.

Parker City Bridge, 40.1 miles below French Creek.—Length, 790 feet; with 4 equal spans. The channel is through the second span from left shore. It is an iron bow-string girder, 27 feet wide over all, elevated 34.5 feet above low-water surface. The Parker, Kearns City and Butler Narrow Gauge Railroad crosses this bridge to the depot of the Allegheny Valley Railroad. It is also adapted to the use of wagons. Parker City is a thriving oil town of about 2,500 inhabitants. The business street is along the river. An inclosed elevator, set into the hillside, takes passengers to the top of the bluff, on which, judging from a moonlight view, are several fine streets and many neat cottages. The view up and down the river is fine. The Butler County oil region is tributary to this point. From the bridge there is a stretch of more or less swift shoal, and wide river, 0.9 mile to Trout Run Ripple.

Trout Run Ripple, 41 miles below French Creek.—Depth, 0.7 foot; length, 500 feet; fall, 2.0 feet. This shoal could easily be improved by confining all the water to the left of the bar. Parker's Falls comes immediately below and nearly opposite the mouth of Bear Creek.

Parker's Falls, 41.3 miles below French Creek.—Depth, 1.5 feet; length, 1,350 feet; fall, 4.124 feet; velocity, 4.9 miles per hour. (At this stage, it is the swiftest rapid in the river.) This is one of the well-known rapids of the Allegheny through which steamers are often obliged to *cordel*. A former steamer-clerk, now in the oil business, whom I accidentally met at this place, informed me that the river was now nearly 2 feet below a safe stage for steamer navigation. He had, however, passed up through this rapid and others on boats drawing the full depth of the channel, frequently rubbing the bottom, &c. His remarks were interesting, as they seemed to show that, with the river as at present, there must be 2.5 feet depth on the rapids for safe navigation. He seemed to think that if the channel was cleared of the numerous dangerous rocks, steamers might then ply on the Allegheny at less depths. At Parker's Falls some water is spread over the right half of the river, but the great body of it is all down the left and close to a solid rock ledge. There would, therefore, be little use for a wing-dam, though the erection of a guide-wall, to the height of 8 feet, along the ledge, might be of service to keep boats off the shore-rocks and enable them more conveniently to *cordel*. Some of the loose rocks should also be taken out of the channel, in order to make it 50 feet wider, of full depth. On the shore-rocks at this point may be found several well-preserved "carvings" by prehistoric men, representing animals. One is possibly a lynx, 4 feet long, but represented with antlers. Another may be an alligator. There are others undistinguishable, being nearly effaced by the wear of the water, which covers them in high stages, and by ice. The rock is hard sandstone. Thence good water for over 1 mile to Rattlesnake Ripple.

Rattlesnake Ripple (Upper), 42.6 miles below French Creek.—Depth, 0.5 foot; length, 500 feet; fall, 2.032 feet.

Rattlesnake Ripple (Lower), 42.75 miles below French Creek.—Depth, 1.5 feet; length, 1,700 feet; fall, 2.048 feet. Channel enters the uppermost ripple from mid-river, and turns in close to right bank. The bottom is composed of gravel. A low wing-dam from the left shore to the bar in mid-river would increase the depth. Rounding out from the right bank into the pool, which is only 300 feet long, the channel is again in mid-river, and so passes through the second ripple. One small rock should be removed here. Thence for 3 miles through Miller's Eddy, passing Monterey Station, a village on the Allegheny Valley Railroad, the Mineral Ridge Coal Works, &c., the river is good to Black Fox Island.

Black Fox Island Ripple, 45.8 miles below French Creek.—Depth, 2.0 feet; length, 1,400 feet; fall, 2.34 feet. The map of 1828 shows most water down the left chute; now nearly all of it takes down the right chute. No trouble here. Thence good water 1 mile to Eagle Island.

Eagle Island Ripple, 46.8 miles below French Creek.—Depth, 3.0 feet; the channel follows the right shore. The ripple is scarcely appreciable, and there is no trouble.

Thence the water is good 2.7 miles through Truby's Eddy (said to be 40 feet deep in places; our deepest sounding was 28 feet) to Armstrong Ripple.

Armstrong Ripple, 49.5 miles below French Creek.—Depth, 1.5 feet; length, 1,400 feet; fall, 1.7 feet. There is a low bar on the left, behind which some water escapes. The approach to the rapids for half a mile is a widespread shoal with smooth bottom. A wing-dam from the left would improve both the rapid and this shoal, but it may not be necessary. Thence good water, through Sarah Furnace Eddy, 1.5 miles to Catfish Rapid.

Catfish Rapid, 51 miles below French Creek.—Depth, 1.0 foot; length, 900 feet; fall, 3.88 feet. This is an exceedingly bad place. The current at the head from mid-river sets strongly towards the left bank, which is rough and stony. From the shore it is again deflected to mid-river below. The place might be improved by straightening the channel on the right at the head by the removal of gravel and stone, while the left side lower down could be excavated in order to ease the turn. Improving the depth may be attended with difficulties. It must certainly be a dangerous rapid at an intermediate stage. The river is too low for us to judge very well how the current might act when several feet higher. An old mill worked by the fall of the river formerly stood on the right bank. It was peculiarly located over a fissure between two large rocks through which a small "mill-race" still runs. Thence good water 1.5 miles, through Catfish or Siebert's Eddy, to Sugar Creek Rapid.

Sugar Creek Rapid, 53.6 miles below French Creek.—This is a long ripple extending for three-quarters of a mile above Brady's Bend Bridge, but not swift, and with a least depth of 1.5 feet. At its lower end it terminates in an abrupt rapid; depth, 1.5 feet; length, 1,900 feet; fall, 2.87 feet. Other rapids, with a greater descent in less distance, have not the velocity of this one, which is very swift. Troublesome as such places always are to navigators, the fact that the Brady's Bend Bridge has its first pier from the left shore set exactly in the middle of the channel, adds tenfold to its difficulties. To make matters worse, an extra large quantity of riprapping of the pier was necessary, or was at least employed, which further diminishes the chances of a safe passage through. I was informed that many rafts were lost against this pier until the raftsmen learned to hold their crafts close down the left shore and pass through under the abutment span. Practically, therefore, this bridge leaves a channel-way for rafts at intermediate stages of only about 150 feet. The removal of this pier would be the most decided improvement which could be suggested, although the removal of some of the riprappings would of course be an aid.

The Brady's Bend Bridge, 53.7 miles below French Creek.—Entire length, 750 feet. It is a through Howe truss of wood, much dilapidated. Since the abandonment of the Brady's Bend Iron Works (on the right bank), it is no longer used for railway purposes. It has four spans of the following lengths, measured from the left shore: 192 feet, 200 feet, 200 feet, 158 feet. The height in the clear above low-water is 35.7 feet. Thence good water through Brady's Bend Eddy to Goose bar.

Goose Bar Ripple, 56.4 miles below French Creek.—Depth, 1.0 foot; length, 300 feet; fall, 0.5 foot. Gravel bottom and no rocks. If desired, a wing-dam 500 feet long from the left shore would accomplish the object of deepening the channel. Thence 1.4 miles to Frazier's Ripple, through "eddy" or good water.

Frazier's Ripple, 57.8 miles below French Creek.—Depth, 2 feet; length, 1,800 feet; fall, 0.50 foot. The channel is down the left of the central bar. No improvement required. Thence good water to Red Bank Creek, 1.6 miles, though the pool approaching the creek gradually becomes a general shoal.

Red Bank Creek Ripple, 59.4 miles below French Creek.—Depth, 0.5 foot; length, 800 feet; fall, 1.66 feet. At this place the river is very wide, the water straggling over it, with detached bars showing out of water in various positions. We found the best channel close in to the right shore, but even there our boat, drawing 6 inches, rubbed the bottom. We measured the length of the ripple on the right bank, beginning at a point opposite the mouth of Red Bank Creek. For a low-water improvement, a long wing-dam from just below the mouth of the creek (which enters on the left) three-fourths of the distance across the river would probably be necessary. Below this upper ripple the channel on the right is gradually re-enforced with water from the left side, issuing at right angles from between bars. The whole stretch of shoal river here is about a mile in length, terminating at the lower end with a rather strong ripple, with a depth of 1.5 feet. In this last ripple a few stones could be removed to advantage.

Red Bank Creek is a noted lumbering stream, and drains Jefferson County, Pennsylvania, &c. It is up this stream to its head that the "Low Grade Division" of the Allegheny Valley Railroad extends, crossing the Allegheny divide to the waters of the Susquehanna River at Driftwood, on the Philadelphia and Erie Railroad. This route is remarkable from the fact that, with a summit-tunnel only 1,965 feet in length, the railroad crosses the mountains with a grade not exceeding 33 feet per mile. Were it not for the detour to the north, this would make probably the best route for a trans-Allegheny canal anywhere south of the New York line, for at no other point is the divide so low and so easily approached. Years ago it was suggested as a canal-route,

but its merits have never received an investigation. Franklin Wright, civil engineer, in 1854, was the first engineer to report the existence of the route, but his surveys were for railway purposes. The Allegheny Valley Railroad Bridge over the mouth of Red Bank Creek measures 324 feet between abutments, and it is divided into two equal spans; it is a through covered Howe truss, of wood. From the foot of Red Bank Ripple half a mile of good water extends, through McClatchey's Eddy, to Early's Rapid.

Early's Rapid (Upper), 61.1 miles below French Creek.—Depth, 1.5 feet; length, 1,200 feet; fall, 1.95 feet. The channel would be easy and safe if about a dozen rocks were removed. One rock, 12 feet by 3 by 3, was just protruding above the surface. There was a large island here in 1828, but nothing now remains of it but a bar, covered at a 5-foot stage. A short stretch of good water conducts to the lower rapid.

Early's Rapid (Lower), 61.6 miles below French Creek.—Depth, 1.5 feet; length, 1,200 feet; fall, 3.641 feet. This is a powerful rapid. Here the river and channel is in one body down mid-river. A number of rocks make it dangerous for a low-stage navigation (the current and a strong wind combined nearly wrecked our boat on the rocks), but here, as in general along the river, the rocks referred to are of a size easy to lift; most of them could be raised by hand alone. Thence good water one mile to "Dixon's Chute" Ripple.

"Dixon's Chute" Ripple, 63.0 miles below French Creek.—Depth, 2.0 feet; length, 950 feet; fall, 2.78 feet. A bar on the right below the mouth of the creek confines the water somewhat, but the "chute" is of ample width. The current, however, is quite strong, the velocity at the time being three miles per hour. A few rocks could be picked off to advantage, but nothing else seems to be required. Coal is mined in the hills along this part of the river. One individual expressed the wish that the river may be improved, so that coal could be shipped in light flatboats to the upper oil regions, where the fuel is inferior. No one, however, proposes to ship Allegheny River coal to Pittsburgh, fearing it to be a veritable "New Castle." Thence good water, through American Furnace Eddy, 1.8 miles to "Nellie's Chute" Ripple.

"Nellie's Chute" Ripple, 64.8 miles below French Creek.—Depth, 1.5 feet; length, 2,700 feet; fall, 3.762 feet. This is a connected series of rapids. Near the foot occurs the greatest fall, which is 1.685 feet in 500. The channel is crooked at the lower end, but not difficult. A small quantity of water escapes to the left of the bar. At the upper end there is a rock which projects 1.5 feet above the water, containing approximately 4 cubic yards. There are, besides, several other smaller rocks further down, which could be removed to advantage. Thence good water through Gray's Eddy 2.7 miles to Upper Mahoning Ripple.

Upper Mahoning Ripple, 68.0 miles below French Creek.—Depth, 2.5 feet; length, 500 feet; fall, 2.10 feet. The river approaching the ripple, and about opposite the mouth of the Mahoning, has less depth (1.5 feet) than the ripple itself. There are a great many scattered rocks which, if picked out, would make a safe depth of 2 feet through this place. The channel in the rapids is only about 200 feet wide. A few hundred feet below is the lower ripple. Mahoning Creek enters from the left; it is quite an important tributary of the Allegheny. The through covered railroad bridge over the Mahoning is 305 feet in length, with two equal spans of wooden trusses strengthened by arches. Its height above low-water is 32 feet.

Lower Mahoning Ripple, 68.4 miles below French Creek.—Depth, 3.0 feet; length, 350 feet; fall, 0.64 foot. No trouble here. Thence good water 1.3 miles to Orr Hill Island Ripple.

Orr Hill Island Ripple (Upper), 69.7 miles below French Creek.—Depth, 2.0 feet; length, 250 feet; fall, 1.16 feet. This ripple is opposite the upper end of the towhead of the upper island. Material changes have occurred in the shapes of the two islands here since 1828, both having been washed away considerably, and as a consequence large areas of bar are exposed. The channel passes to the left of both islands and near the left shore. At intermediate stages much water escapes between the islands and between them and the right shore, and appearances indicate that the channel may change here at some future time, but as there is no special difficulty at present, plans for improvement may be deferred.

Orr Hill Island, Lower Ripple, 69.7 miles below French Creek.—Depth, 2.0 feet; length, 850 feet; fall, 1.15 feet. This ripple is opposite the point of the second island. No special trouble. Thence good water 2.5 miles to Pine Creek Ripple.

Pine Creek Ripple, 72.5 miles below French Creek.—Depth, 2.0 feet; length, 1,800 feet; fall, 2.34 feet. Although the depth here is 2 feet, the channel is so tortuous that it would require the removal of numerous rocks (none probably over one and a half tons in weight) to secure a safe depth of 2 feet for steamboats. Thence good water, through Peart's Eddy, 1.8 miles to Cowanshannock Rapids.

Cowanshannock's Rapids, 74.8 miles below French Creek.—Depth, 1.0 foot; length, 500 feet; fall, 1.16 feet. The island shown here in 1828 as 2,000 feet long, has entirely disappeared, giving place to a long, low bar covered at a two-and-a-half-foot stage of the river. The channel is down the left of the bar. The river appears to be changing,

and may eventually have its channel down the right, over the former site of the island. The water to the right of the central bar stands at a higher level than it does in the channel, in the manner described at Foster Island, Red Bank, and above Parker City. By means of a wing-dam from right shore, possibly continued downstream after it reached the bar, the channel could be maintained in its present course, and with an increased depth. Fire-clay is shipped from this place to Pittsburgh. There are a number of rocks and bowlders which could be removed to advantage at this place. Thence through Lemman's Eddy there is good water over 2 miles to Castaway Rapid.

Castaway Rapid, 77.5 miles below French Creek.—Depth, 2 feet; length, 1,200 feet; fall, 2.8 feet. The river here is very wide, and a large "towhead" or high bar, in mid-river, nearly obstructs it, throwing the channel from mid-river directly towards the right shore. Nearly the entire volume of the river at this stage takes the right chute, but the width of the navigable channel is not much over 75 feet. On account of the abruptness of the turn in entering the chute, boatmen experience much difficulty. Dredging might be resorted to to improve this place. Thence about half a mile is the Kittanning Bridge.

Kittanning Bridge, 78.3 miles below French Creek.—This is a highway bridge, built of iron bow-string girders. It is 900 feet long, with five spans 180 feet from center to center of piers, elevated 32.7 feet in the clear above the surface of low-water. Kittanning, 44 miles above Pittsburgh, is one of the oldest towns in Western Pennsylvania, and has a population of about 5,000. It is the county seat of Armstrong County.

Ripple, below Kittanning, 78.9 miles below French Creek.—Depth, 1.2 feet; length, 150 feet; fall, 7½ inches. As usual, a few rocks could be removed here to advantage. Boatmen apply the term "Castaway" to the whole extent of river from the Castaway Rapid to this one. Such powerful winds prevailed that we were unable to judge whether the channel between the rapids requires improvement or not; it is most probably free from dangerous rocks or other obstructions. Thence there is good water 1.1 miles to Cogley's Island.

Cogley's Island Ripple (two), 80.2 and 80.7 miles below French Creek.—Upper ripple, depth, 1.3 feet; length, 400 feet; fall, 9 inches. Lower ripple, depth, 1.2 feet; length, 500 feet; fall, 1.26 feet. The island formerly at this place is almost gone, nothing being left but a long, low bar connected with the right bank, the upper half of which is covered at a 1.5-foot stage, and all of it is under water at a 5-foot stage. Between the two ripples is swift water, with a depth of 3 feet. In the lower ripple, along the right shore, are numerous rocks and bowlders (none more than one-half a cubic yard in volume), which so obstruct the channel that boatmen have built small wings to throw the current towards the bar, so that they may pass these obstructions in safety. Thence through Montgomery's Eddy the river is good to Zuver's Island.

Zuver's Island Ripple, 82.6 miles below French Creek.—Depth, 3.0 feet; length, 800 feet; fall, 1.49 feet. Considerable changes have occurred here in the shapes of the islands and bars since 1828. It might possibly be of service to close the left chute of Zuver's Island. Ross is the name of the second or largest island. Thence half a mile through Grey's Eddy there is good water to Nicholson's Rapid.

Nicholson's Rapid, 85.7 miles below French Creek.—Depth, 1 foot; length, 5,100 feet; fall, 4.87 feet. The fall is mostly concentrated in the 600 feet at the foot of the upper island. The water nearly all passes to the right of the island. The channel entering the chute is shoal at the head and continues so all the way down. Opposite the foot of the first island (the two islands being connected by a dry gravel bar) is Nicholson's Rapid proper—a bad place. Through Nicholson's, the usual channel is along the right shore, but on account of numerous small rocks it is not practicable in low-water. The safest water is to the left of the small bar in mid-river (just showing), but it is quite swift. Thence it continues more or less swift and shoal (but not troublesome) for half a mile to a short, bad ripple, which has a fall of 2.54 feet in less than 2,000. At this last place the channel is divided by a small bar or lump of gravel. We passed to the left through a "suck," or passage, 2 feet deep, scarcely more than 25 feet wide, which was wonderfully swift for a short distance. For the improvement of Nicholson's Rapid I would recommend that a dam be built to close the left chute of the island, and another quite low one to extend from the island to the bar; the removal of the rocks mentioned above would also be advisable. At the lower rapid there being no channel whatever one must be made by means of dredging. I think that the trouble here must have been caused by the action of a recent ice-gorge, possibly last winter. Such gravel lumps as are found in this swift water could not long withstand the ordinary action of ice and drift, and the effect of the passage of boats. Thence 1 mile of good water through Pickle's Eddy to Walker's Bar Ripple.

Walker's Bar Ripple, 89.1 miles below French Creek.—Depth, 3 feet. Walker's Bar has changed but little since 1828. The ripple is exceedingly gentle, the channel is straight, and there is no trouble to navigation. Good water thence nearly 1 mile to Murphy's Island.

Murphy's Island Ripple, 90 miles below French Creek.—Depth, 1 foot; length, 4,400 feet; fall, 2.74 feet. Nearly all the river passes down the left chute of this island,

which is narrow but direct. It is throughout rather swift and shoal, the depth varying from 3 to 5 feet. At its head the depth was only 1.5 feet. A few rocks in the channel near the lower end have been grazed by boats. The worst part of the ripple is at the foot of the island, where there is a depth of only 1 foot. There the channel is divided by a gravel and stony bar. Dredging and the removal of rocks might be used to improve this place. Thence there is good water through a short pool, or "eddy," to Grassy Island or Mad-Dog Ripple.

Grassy Island Ripple, 91.1 miles below French Creek.—Depth, 2.5 feet; length, 700 feet; fall, 1.04 feet. Here a large, high bar, projecting from the left shore, occupies three-quarters of the width of the river. The channel is close in to the right shore. The only trouble is that at high stages it is difficult to keep rafts from striking the large rocks along the concave shore. Three or four of these rocks, 25 feet by 15 by 10, might be blasted away. Thence 1.5 miles of deep water to the mouth of the Kiskiminetas River. As we passed through this pool we could distinguish the bottom wherever the depth did not exceed 16 feet.

Kiskiminetas River Ripple, 92.7 miles below French Creek.—Depth, 1.8 feet; length, 700 feet; fall, 2.8 feet. This rapid occurs along the right shore of the river opposite the mouth of the Kiskiminetas, which has thrown out into the Allegheny a large, low, flat bar. There is no special difficulty in the navigation of this rapid. It would, however, be an improvement to remove another course from two of the five old piers of the demolished Pennsylvania Canal aqueduct bridge, portions of which still remain in the river. The canal crossed from the right or west bank of the river just above the mouth of the Kiskiminetas, and thence went up that river and its tributary, the Conemaugh, to the Portage Railroad, by which boats were carried across the Allegheny Mountains. The Allegheny Valley Railroad crosses the Kiskiminetas on an iron deck bridge 707 feet long, in five spans, elevated 31 feet above the surface of low-water in the Kiskiminetas River. Just below the rapid the West Pennsylvania Railroad, which comes up the right bank of the Allegheny River, crosses that river on a deck bridge of wooden trusses strengthened by arches. The total length of the bridge is 795 feet, in five spans of 185½ feet each. The rail is 57 feet above low-water, and the bottom chord is 38 feet above the same level. The two railroads cross each other, on grade, at West Penn Junction. On the right, below the West Penn bridge, is the town of Freeport, from which point to the mouth of the Allegheny, a distance of 30 miles, the river was regularly surveyed in 1875 by Lieutenant Mahan, under your instructions. The Kiskiminetas, like all the east side tributaries, was remarkably low. No point presented favorable conditions for gauging its discharge, but I should judge that it was flowing about 5,000 cubic feet of water per minute, or about one-eighth of the discharge of French Creek, and only one twenty-fifth the discharge of the Allegheny. With some knowledge of its sources in the Allegheny Mountains, I am inclined to the opinion that for some climatic cause prevailing during the present year it had lost the greater portion of its supply by evaporation on its numerous shallow pools. It has a fine width, and in the spring is a large stream, upon which considerable-sized rafts can be safely navigated.

We closed our work in the field on October 21, the river at the time being as low as it was ever known to be.