not permit the construction of dams that will give great depths. Consequently the decision adopted was on the eve of becoming a dead letter when new methods were proposed.

We will examine in succession these projects whose models have been exhibited at the Champ-de-Mars or at the Trocadero.

The first one, due to M. Caméré, engineer of *Ponts-et-Chaussées*, has just been indorsed by a ministerial decree, which has decided to apply it at the Poses Dam.

The following is a concise description of the Caméré apparatus:

DESCRIPTION.

As the distinctive character of this style of dam consists especially in the parts that hold back the water, we will begin by describing them, all the other parts of this system having been specially adapted to the means of closing the openings.

Let us suppose a series of uprights, vertical or slightly inclined, standing up from the floor of the dam, and that we commence at the level of the floor, ending at the level of the pool, and place horizontally a series of wooden or metallic bars of small height, whose ends are held between ribs constructed on these uprights.

In addition, let us suppose all of these bars to be connected on their upstream sides by articulations, and that the top bar of the curtain thus made is suspended by two chains fastened to a horizontal transom connecting the uprights above the level of the pool.

Lastly, let us suppose that to the lower bar of this curtain, which has a rectangular cross-section, there is joined another bar with a rounded cross-section, around which is passed an endless chain, one of whose lengths is on the downstream side of the curtain, and the other on the upstream side, and both of which pass over the chain-wheels of a windlass of special construction, placed on a service-bridge hanging to the uprights.

If, while the curtain is in this position, during which time the dam is closed, the windlass is put in motion so as to shorten the upstream part of the chain, the round bar at the bottom commences to rise and to rotate; in so doing the whole or a part of the curtain rolls up around it, thus unmasking a larger or smaller part of the bay in question.

On the other hand the reverse maneuver causes the unrolling of the curtain and the more or less closing of the bay.

Having thus pointed out the principles on which rest the construction and maneuver of the apparatus in question, we will now pass to the description of what is more properly the dam itself.

On a floor with a continuous surface extending over the whole width of the river, are erected piers and abutments, which divide the discharge through the dam into a certain number of passes, according to the amount of opening to be preserved.

On top of these piers or abutments, and at a suitable height, is placed a truss to which is suspended on the upstream side and at equal distances a series of uprights whose lower ends rest against a row of stops embedded in the floor.

At a height of 3 feet 3 inches above the level of the proposed pool the uprights support the segments of a flooring which when joined together form a continuous service bridge the whole length of the dam.

It is upon this service bridge that the windlasses travel that are intended for maneuvering the curtains that close the spaces between the uprights and are supported by them.

The foregoing, so far as the closing of the water-way is concerned, are the essential features of the dam and of its method of operation during ordinary stages. The following are the provisions made for floods, and for stages when the passes of the dam are navigable.

Between each pair of uprights, and at the level of the foot-bridge, vertical frames are placed, having rollers on each side which run in grooves arranged in the sides of the uprights, and extending from their upper extremities down to the service bridge.

Upon these frames there are sheaves for the curtain-chains, sheet-iron boxes to hold them, and chain-stops; and in addition there are resting places for the curtains when they are completely raised.

With such an arrangement it will be easily understood that as everything necessary for the closing of a bay is brought together on a frame it will only be necessary when the river is to be restored to its normal condition to raise the frame between the uprights (which serve as guides) up to the upstream face of the truss, where, when properly fastened, it is conveniently stored during the time that the dam remains open.

As for the uprights themselves, the following is the manner in which they are raised at the desired moment.

Each one of them is fastened to the truss only by an axis resting upon a pair of pillow-blocks bolted to the truss, thus permitting the uprights to turn around their axis of suspension, and to take a horizontal position above the river surface and parallel to its course, and at the level of the truss.

To accomplish this movement of the uprights a second foot-bridge is placed above the one which is used to support the upper ends of the uprights when erect. Upon this second foot-bridge there are traveling windlasses which act upon chains that at the moment of the maneuver are hooked into short lengths of chain attached to the lateral faces of the uprights near the center of gravity.

This second foot-bridge, under which the uprights are placed after being raised, is furnished in addition with safety-hooks, which assure the maintenance of the uprights in their proper horizontal position.

With regard to closing the dam, the operations just described must be executed in the reverse order, as follows:

1. Lowering of the uprights.
2. Lowering of the curtain-frames to the level of the service bridge.
3. Unrolling of the curtains to the extent required by the necessities of the pool.

PECULIARITIES AND ADVANTAGES OF THE PROPOSED DAM.

TYPE OF MOVABLE DAM ADOPTED BY THE GOVERNMENT FOR THE SEINE BETWEEN PARIS AND ROUEN.

From the decisions of July 14, 1876, and March 25, 1877, it results that the government has sanctioned for use on the Port-Villez Dam the employment of trestles supporting either needles or gates like those at the Port á l'Anglais Dam [Boulé system], in preference to any other system of movable dam.

It will therefore be sufficient for us to compare with this style of dam the new system which we present, in order to show the propriety of its adoption in place of the former.

NEEDLE-DAMS.

Whenever a lift of 10 or 11 feet is exceeded the application of the Poirée system involves the use of trestles of great weight, and of needles of a cross-section so great as to render them unmanageable except by the aid of machinery.

This is, in fact, the case at the Port-Villez Dam, which has a lift of 13 feet, thus necessitating trestles having a height of 18 feet, and weighing 3,750 pounds, and of needles with a length of 18 feet, a cross-section of 8 by 8, and a weight when wet of 386 pounds.

Besides these objectionable features, which in case of a dam of 16 feet lift would be sufficient to prevent its adoption, the system of needle-dams presents the following additional faults, particularly when high lifts are under consideration.

1. The necessity, in order not to increase the lengths of the needles, and consequently their weights, of placing the service bridges very little above the level of the pool; whence the danger of being surprised by a rise before the dam can be lowered.

2. The dangers that must be incurred by the men employed in maneuvering on account of the small width of the foot-bridges, of the lack of points of support, and of unexpected falls of trestles badly hooked, &c.; dangers which are considerably increased in winter and in stormy weather.

3. The inconvenience due to the fact that the needles extend some distance above the level of the pool, and thus prevent any surface overflow, which overflow of itself would be sufficient during the low-water season to regulate the surface of the pool and to prevent surprises by slight rises.

4. Lack of tightness during low-water, a fault which necessarily becomes more marked as the lift increases, and justifies the conclusion that for a given discharge there is a limit of height of lift which cannot be exceeded. By way of example, we cite the dam of Notre Dame de l'Isle, which, during low-water, is unable to keep up a lift of 8½ feet.

5. The inconvenience of having to lower to the bottom of the river all of the trestles, which, in spite of being recessed, are subject to all sorts of accidents, which are the more difficult to see and repair since everything is under water.

6. The inconvenience of being obliged to transport to and from storehouses on the bank all the hooks, balks, flooring, and needles whenever the dam is to be lowered or raised.

7. The inconvenience that arises from inability to begin raising or lowering the trestles at any point whatever of the pass, a fact which, in case of injury to a trestle, might compel a suspension of operations, to the great damage either of the works or of navigation; in any event the rapidity of the maneuver is retarded.

8. The disadvantage of requiring floors of complicated form, into which enters iron work of great weight, which it is impossible to inspect, and which is a source of anxiety for the future.

In the dam at Port-Villez this iron work represents a weight in round numbers of 1,750 pounds per running foot.

9. Lastly, the necessity of employing, in addition to the regular workmen, laborers who are skilled in handling needles, of whom there are very few in the neighborhood of the dams.

DAMS WITH TRESTLES AND GATES.

Dams composed of trestles and gates, by reason of the weights of the trestles, which increase in proportion to the height of the lift, have naturally a limit to their practical application; and in view of the weight of 3,750 pounds developed in the trestles at Villez, it seems to us that the height of 13 feet is very near this limit.

Having said this much, it is certain that the use of gates, instead of needles, does away with the difficulties recited above in articles 1, 3, 4, and 9; but those named in articles 2, 5, 6, 7, and 8 still remain, and to these we may add the following:

A. The fact that the machinery for maneuvering has not yet been sufficiently tested in practice, and that it happens to require the exercise of considerable power.

B. The chances that the gates, when lifted in a slightly oblique direction, may become jammed between the trestles like the drawers of a table, which would be a serious difficulty when maneuvering the dam.

C. The difficulty, when the current is strong, of hooking onto the lower gates by means of a pole at least 20 feet long; for even though, as a rule, no maneuvering is necessary, except when the difference of level above and below the dam is very slight, it is nevertheless certain that the parts should be such that they could be handled under all circumstances, even under those the least to be expected, as, for example, when there is the full height of fall.

DAMS WITH HINGED CURTAINS AND HIGH FOOT-BRIDGES.

With the system adopted for the proposed dam at Poses, the height of the lift becomes of only secondary importance, and we must certainly attempt heights not at all likely to occur in actual practice before arriving at impossibilities either of construction or of management.

To this important advantage this system adds the following:

1. The possibility of placing the service-bridges sufficiently above the level of the pool to be beyond danger from any surprise.

2. Complete security for the workmen during the maneuvers even at night, by employing lanterns to light up the vicinity of the windlasses.

3. Possibility of permitting the water to flow over the whole length of the dam, which enables us to avoid the incessant maneuvers which are required with needles, and relieves the dam from danger from sudden rises.

4. The tightness, almost absolute, of the dam.

5. The facility of looking after and of repairing the movable machinery by reason of its being wholly above water when the dam is open.

6. The getting rid of the necessity of transporting to and from the storehouses all the apparatus used for damming the water and for completing the service-bridges, except, of course, when repairs are needed.

7. The possibility of beginning the maneuver of the dam at any point whatever, so that, in case of accident to a movable upright, for example, neither the opening nor the closing of the dam is hindered while the obstacle is being removed, together with the possibility, should it become necessary, of greatly increasing the rapidity of the maneuver.

8. A considerable simplification in the construction of the floors, and the suppression of the masses of immersed iron-work, which it is evidently much more logical to use where they will be out of the way of floods.

9. The possibility of employing ordinary laborers for the maneuvers, which merely consist of fastening chains and putting windlasses in motion.

V 2.

IMPROVEMENT OF MONONGAHELA RIVER, WEST VIRGINIA AND PENNSYLVANIA.

No work was done on this river during the fiscal year ending June 30, 1878. An appropriation of $25,000 for completing the lock and dam at Hoard's Rocks was made by the river and harbor act approved June 18, 1878.

The work was assigned to Mr. William Weston, assistant engineer, who arrived at Hoard's Rocks on the 25th of July, and at once resumed operations. A month was necessarily expended in renewing the old plant, which had greatly deteriorated, and in procuring additional boats, tools, steam-pumps, &c. The locality is not easily accessible at best, and the work was greatly embarrassed by the failure of Lock No. 5 in the Monongahela slackwater, which made it impossible to bring up the pump-boat which had previously been used. All freight had to be transferred over Dam No. 5, thus seriously interfering with the delivery of cement and machinery, besides adding to their cost.

In consequence of these delays and the necessity of renewing the coffer-dam which had been washed away during the two years' stoppage, a large part of the low-water season had passed before active work could be resumed. The first masonry was not laid until the end of August.

Work was pushed as rapidly as possible, and in September, section 3 of the coffer-dam was pumped out, and some new foundation masonry was laid. The pumping out of this section revealed the fact that the end of the old foundation course was resting on 3 feet of gravel. Further examination showed that this gravel foundation extended under the outer 60 feet of the old foundation, thus necessitating the removal and relaying of this length of old work.

These facts were not known at this office, but it was supposed that, in obedience to orders, the dam as far as built had been founded on rock. Acting on this belief, several courses of masonry were laid on the inner end of the defective section, all of which had to be torn up and relaid. The additional delay due to this reconstruction at a time when the usual low-water season was nearly ended was the direct cause of the practical failure of last season's work.

By the 5th of October, section 3 had been built up to a height of 5 feet above low-water, and there remained only a gap of 55 feet to be filled with masonry at a depth of 9 feet below low-water.

This section gave great trouble on account of the mass of *débris* and gravel that obstructed it, and made it very difficult to establish a tight coffer-dam. By the 21st of October this section was pumped out and cleaned and masonry was begun. During the night of October 23, a rise from the Cheat River backed up the water at Hoard's Rocks and overflowed the coffer-dam from below, after two-thirds of the foundation course had been laid. By the 25th, the main river had risen so as overflow the masonry in section 3.

After waiting until the middle of November, and the river still continuing too high for work, orders were given to suspend operations for the season. Work on the lock-gates continued until January 24, at which date they were finished ready for hanging.

In a report dated January 29, 1879, I gave a full statement of the condition of the work at Hoard's Rocks and the cause of the failure to

complete the lock and dam, and requested a further appropriation of $24,000. This sum was appropriated in the river and harbor act approved March 3, 1879.

Authority to resume work under this new appropriation was granted on the 7th of June, and on June 14 active operations were begun.

By the close of the fiscal year the flatboats had been caulked and put in order, derricks had been raised, pumping-machines had been overhauled, and the new coffer-dams had been nearly completed.

Since the close of the fiscal year the gap in the dam has been built up to the level of 5 feet above low-water, and as the most hazardous part of the work has been completed, there is every reason to expect that the whole work will be finished before Congress reassembles in December.

During the fiscal year there was laid 1,800 cubic yards of masonry (300 yards taken up and relaid), 350 cubic yards of gravel were excavated in preparing foundations, 400 cubic yards of stone were quarried, and 700 cubic yards were boated to the dam.

Assuming that the lock and dam at Hoard's Rocks will be completed by the end of the present season, the situation will then be as follows:

From Pittsburgh, Pa., to Morgantown, W. Va., is a distance, measured by the river, of 102 miles. On this length of river there will then be 7 dams, of which the first 6 (counting from Pittsburgh) create a system of slackwater navigation to Jacobs' Creek, 84 miles above Pittsburgh. These dams were built many years ago, and they belong to the Monongahela Navigation Company. From Jacobs' Creek to Hoard's Rocks, a distance of 9½ miles, there is no slackwater. At Hoard's Rocks the government lock and dam make slackwater to Morgantown.

To fill the gap between the slackwater belonging to the navigation company and that belonging to the United States, it will be necessary to construct two more dams having a total lift of 20 feet. One of these dams must be built at Jacobs's Creek, and the other should go at the the most favorable site in the vicinity of Laurel Run. The lock and dam at Hoard's Rocks is therefore No. 9 in the system, counting from Pittsburgh, and the question is who shall build Nos. 7 and 8, in order to make the system complete and available to commerce.

In accordance with their charter, the Monongahela Navigation Company is bound to begin lock and dam No. 7 as soon as the construction shall have been commenced of sufficient locks and dams to extend slackwater from the State line to Morgantown. The company have notified me of their willingness to comply with this condition, and have promised to begin as soon as the government begins on No. 8.

It is true that the United States might call upon the navigation company to build No. 7 to such a height as would extend slackwater to the State line, but that would not bring slackwater up to the Hoard's Rocks lock, as Crooked Run Ripple intervenes.

If No. 7 were built with a lift of 15 feet, and some dredging were done at Saddler's Bar, a navigation depth of 4 feet would be carried up to the State line, but another lock and dam (No. 8), with a lift of 5 feet, would be required to connect with the Hoard's Rocks lock and dam.

Inasmuch, therefore, as two more locks and dams are needed, it is much better to give both of them the lift of 10 feet (which experience has shown to be about the most serviceable lift) than to give one of them the excessive lift of 15 feet and the other the very low lift of 5 feet. But as the company can fulfill its obligations with a single lock and dam, if it should so elect, I think that they ought not to be called upon to build more than this one (No. 7), and that the other (No. 8) should be built by the United States. Until No. 8 is built No. 9 will be of little or no service to navigation.

In my first report on the improvement of the Upper Monongahela (Report of Chief of Engineers, 1872, page 412), I discussed these subjects, and concluded that the permanent advantage of the country would be subserved by treating the question from an engineering standpoint, and recommending the system that would ultimately prove the most efficient. The result is to cause the navigation company to build a lock and dam of the height that experience has shown to be most advantageous, to relieve them from the obligation of increasing this height to a dangerous degree, and to throw upon the United States the obligation of completing the missing link.

In view, therefore, of the fact that the Hoard's Rocks lock and dam is, as it were, "in the air," and of the additional fact that every dollar spent on No. 8 necessitates the expenditure by the navigation company of another dollar on No. 7, thus producing a double result, I would strongly urge the commencement without delay of a lock and dam in the vicinity of Laurel Run. I have, therefore, the honor of renewing my estimate of $115,000 as the cost of a lock at Laurel Run, and would ask for $60,000 for the next fiscal year.

Money statement.

July 1, 1878, amount available	$22,376 39 2,903 15	
Amount appropriated by act approved March 3, 1879	24,000 00	
		$49,279 54
July 1, 1879, amount expended during fiscal year	23,284 47	
July 1, 1879, outstanding liabilities	3,405 30	
		26,689 77
July 1, 1879, amount available		22,589 77
Amount that can be profitably expended in fiscal year ending June 30, 1881.		60,000 00

V 3.

IMPROVEMENT OF LITTLE KANAWHA RIVER, WEST VIRGINIA.

The work of removing obstructions on this river under the appropriation of $18,000 made by the river and harbor act of June 18, 1878, was intrusted to Mr. W. E. Strong, assistant engineer, and operations were commenced on August 25 at Hayes' Island, a short distance above Glenville. During the season the party worked down the river to West Fork Shoal, a distance of 58½ miles, removing 2,036 snags and 861 cubic yards of rock obstructions, besides cutting down 311 leaning trees, trimming 58 and deadening 57 others.

Wing-dams were constructed at the following places:

	Feet in length.
Middle Run Bar	100
Laurel Shoal	175
Acre Island	220
Steer Creek Shoal	250
Grantsville, lengthened	75
Leaf Bank, entirely closing left-hand chute.	
Big Root Shoal	500
Lower Leading Creek	485
West Fork Shoal	300

Eighteen hundred and fifty-three cubic yards of stone was used in constructing these dikes, a large part of which was removed from the channel of the river.

The effect of these structures has been to concentrate the water on the shoal places, thus securing additional depth for navigation.

The work of removing obstructions was resumed on May 24, 1879, two parties being put in the field, one to work above and the other below Glenville. The upper party began operations near Bull Town, and up to the end of the fiscal year they had worked over the river to a point 4 miles above Burnsville, removing 2,570 snags and 179 cubic yards of rock, besides cutting down 3,650 saplings and 1,150 leaning trees, deadening 687 trees, and trimming 206 others.

The party working below Glenville built a wing-dam at Sycamore Bar, one at Red Oak Bar, and one each at Upper Resor, Middle Resor, and Lower Resor Bars, to concentrate the water over these shoals; 1,270 cubic yards of stone was used in constructing these wing-dams.

Besides the construction of wing-dams, this party have cut down 502 leaning trees and 654 saplings, trimmed 100 trees, removed 40 cubic yards of rock obstructions, and excavated 497 cubic yards of gravel, &c., from shoal places in the river near Glenville.

It is probable that by the close of the season the natural navigation of the Little Kanawha, which is limited to rafts and push boats in the region above Burning Springs, the head of slackwater, will be as much improved as practicable. The next step should be to extend further up the present system of slackwater.

During the low-water of 1878 Mr. Strong was employed in endeavoring to find the best location near the head of the present slackwater for the next lock and dam. After careful investigation of several sites, one was found that is believed to fill all needed conditions. I therefore renew the recommendation of my last annual report, that an appropriation of $65,000 be made for this lock.

Money statement.

July 1, 1878, amount available	$18,930 69	
Amount appropriated by act approved March 3, 1879	18,000 00	
		$36,930 69
July 1, 1879, amount expended during fiscal year	6,434 03	
July 1, 1879, outstanding liabilities	2,852 72	
		9,286 75
July 1, 1879, amount available		27,643 94
Amount that can be profitably expended in fiscal year ending June 30, 1881.		65,000 00

V 4.

IMPROVEMENT OF GUYANDOTTE RIVER, WEST VIRGINIA.

The work of removing obstructions under the appropriation of $2,000 made by the river and harbor act of June 18, 1878, was assigned to the immediate charge of J. N. Caldwell, jr., assistant engineer.

Work was begun during the first week in August, and continued till November 5, when operations were closed on account of the exhaustion of funds.

The principal obstruction removed was the ruins of the old lock and dam at Barboursville, W. Va. The funds available were not sufficient to entirely remove this obstruction, but enough was removed to secure a good, straight channel for rafts.

One hundred and ten cords of drift, 1,058 cubic yards of rock filling, 2,257 cubic yards of earth, 3,378 cubic feet of timber, 31 snags and 41 saplings were removed from the river at this point, and an area of about $\frac{1}{10}$ of an acre was grubbed.

At the Falls, 14 miles above Barboursville, 417 cubic yards of loose rock, 161 cubic yards of earth, and 122 cubic feet of timber were removed.

Three snags were also removed from a point about $\frac{1}{2}$ mile above Rogers' (formerly Deusenberry's) mill-dam.

The present condition of the Guyandotte is described by Mr. Caldwell as follows:

In ascending the river when the water is at a low stage we find that, after passing the mouth of Mud River, the volume of water gradually increases. At least this is the case as far up as Logan Court-House, 82 miles above the mouth. The valley is very narrow, there being little bottom-land along the stream. In many places the hills slope down to the water's edge on both sides of the river.

The region is very rich in vegetable and mineral products. Some of the finest timber in the world has been found there, and there are still immense forests from which none of the timber has been cut. Large and valuable deposits of coal, iron, and other minerals have also been found.

The soil of the bottoms is a light sandy loam, and when cultivated is very productive.

The inhabitants of the valley depend on the river almost entirely as a means of conveying the timber and the products of their industry to market, and also of bringing the few necessary dry goods and groceries up from the Ohio, as most of the so-called roads are impassable for wagons; in fact, in many places it is with great difficulty that one can get along on horseback.

Timber in the shape of logs is made up into rafts and floated out when the river is swollen by freshets. The value of the timber thus taken out in a single year has been estimated as high as $300,000.

Large quantities of barrel heads and staves are "driven out." A boom is placed near the mouth of the river, and the heads or staves are thrown into the stream and are allowed to float down until caught by the boom. Men in boats follow them and throw back into the water any that happen to lodge on bars or along the shore. After they have all been collected at the boom, they are loaded into barges or flatboats and conveyed to market. There is great risk run in taking them out in this way, as a sudden rise in the river may cause the loss of an entire year's labor. It is much to be desired that the river might be so improved as to permit such articles to be carried down in boats, which is impossible in the present obstructed state of the channel.

The mere rafting of timber is risky while the river is in its present condition. When a raft is started, the chances are against its reaching the mouth of the river without being broken up; besides, there is always considerable risk to life.

Merchants' supplies, &c., are transported by means of canoes and "push-boats," especially by the latter, the progress of which is much interfered with by the different obstructions, notably the mill-dams, which in no instance have either proper gates or chutes to aid craft in passing them.

I will first describe the obstructions in this river as they were found and then the methods adopted for removing them.

OBSTRUCTIONS TO NAVIGATION IN GUYANDOTTE RIVER.

In making my trip of observation, I chose a "push-boat" as the means of transportation, and I selected a time when the water was at the very lowest boating stage. I thus had a good opportunity of experiencing the difficulties of navigation and of seeing the different obstructions when they were most exposed.

The obstructions to navigation are of two classes: the natural ones, such as shoals, rock bars, isolated rocks, and overhanging trees, and those that have been placed in the river through man's agency; the latter being by far the most serious. We will first discuss the natural obstructions.

Natural obstructions.—The great majority of the bars that obstruct navigation are rock-ledges or gravel mixed with loose rock, but below the Deusenberry dam, which is 13 miles above the mouth, the troublesome bars are generally loose masses of fine sand.

The banks of the river being composed of light alluvial soil, as soon as the trees and brush are cleared from them the erosive action of the water washes the sand into the bed of the river, and at the present time the river below the "Falls," especially between Rogers' (formerly Deusenberry's) mill-dam and the mouth, is shallow, flowing for the most of this distance over a bed of "sand waves," from the crests of which there is a slope both up and down stream, the slope downstream being the more abrupt. The sand is very fine, and as the water flows over it it partakes in a measure of the motion, and the crests of the "sand waves" move gradually downstream. These shoals obstruct the passage of "push-boats" to a considerable extent at a low boating stage.

Shoals of rock occur frequently above the "Falls." They are composed generally of rock in the form of bowlders, but in some instances there are solid ledges. They form obstructions from the fact that the fall over them is considerable, the current swift, and in many instances the channels through them are very crooked. Work to improve the navigation of these shoals has been done at some of them by parties interested, but although this has resulted in giving a greater depth of water, the channel produced is nearly always too narrow, and in several cases where the shoals occur in bends of the river the work has been done near the convex shore, while in rafting stages the strongest current is along the concave shore.

Isolated rocks, varying in size from 1 to 30 cubic yards, are found on the concave banks of almost all bends. A large number of these require removal, as rafts descending in flood stages are frequently injured by striking them.

Snags occur very frequently, and some of them are large, firmly imbedded, and form quite serious obstructions. During the course of my trip of observation I removed 3 from a point about half a mile above Rogers's mill-dam that had caused much trouble for several years.

The course of the river is quite crooked and many of the bends are very sharp, and, in addition to the dangers mentioned above of striking isolated rocks, there are numbers of overhanging trees that add to the difficulties and perils of descending navigation. The presence of these trees makes it difficult to stop rafts at night, as they interfere with access to the shore.

Artificial obstructions.—The artificial obstructions in the Guyandotte River below Logan Court-House consist of the relics of 6 locks and dams built for the benefit of navigation and of 5 mill-dams. Some of these dams have been placed in the river under a license or charter from the State, but others have no authorization whatever. Some of the authorized structures in the bed of the river have been formally condemned by the courts and their removal ordered; but there still remain a number of mill-dams against which no legal proceedings have yet been taken, some of which have charters and others have not.

The 6 locks and dams for the benefit of navigation were erected some 25 years ago by a company acting under a charter granted by the old State of Virginia. They were built of rough timber cribs filled with stone, and were placed 1 at the mouth of the river and the others at distances of 7, 13, 20, 25, and 30 miles respectively from the Ohio. They were very rude in construction, and gross errors were made in the selection of sites. The series was in operation hardly 4 years when it failed, and the remains of the dams formed such serious obstructions that for several years all navigation of the river ceased. After a time, however, through the decay of the timber, the erosive action of the water, and a little assistance from parties interested in the navigation of the river, they were in part removed; but some of them still remain and obstruct navigation. I was informed that all of these dams had been legally condemned and their removal ordered.

NAVIGATION DAMS.

Lock and dam No. 1, at the mouth of the river, is entirely gone, and nothing remains that could form an obstruction.

Lock and dam No. 2 was placed just above the mouth of Mud River. The remnants of this structure were partly removed under your orders. I shall give a detailed description of this obstruction when I come to the report of work done during the present season.

Lock and dam No. 3 was located just below what is now known as Roger's mill-dam, but which was formerly called Deusenberry's. A portion of the lock at this point still remains, but it is in a ruinous condition. It was so located with reference to the chute of the mill-dam that when the navigation dam was carried away and the use of the chute again became necessary the lock was found to be a serious obstruction. The condition of affairs will be more fully explained when I come to treat in detail of this locality.

Lock and dam No. 4.—The lock still remains, but the greater part of the dam has been washed away. The lock is not an obstruction, and the dam is so low as not to seriously impede navigation.