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of brush about 6 inches thick, held down by wires and pickets and covered with earth. The mattresses were uniformly 18 inches thick, and composed of willow brush held between two frames of poles and wires.

Of brush dikes a total length of 2,100 feet was built, but the effect was slight and unimportant. They were not got in until after the river had become low and comparatively free from sediment. Work was resumed April 19, 1879, Assistant Chester B. Davis being in charge. It was found that while the work had successfully resisted the breaking up of the ice, more or less damage had been done to the Iowa revetment during the spring rise.

This damage was mostly confined to the upper bank protection, which proved deficient in endurance, but at the lower end of the revetment some of the mattresses had been carried out. This was probably due to the failure of the upper bank protection, which allowed the revetment to be taken in rear when the bank, which was composed of almost clear sand, washed away and allowed the mattresses to settle. The Nebraska revetment was not injured. As soon as possible the bank above the mattresses was regraded, and the upper bank protection was renewed as fast as the stage of water allowed; this work is not yet completed. At the end of the revetment, where the mattresses had been carried away, a heavy eddy was developed which threatened the safety of the whole revetment. This was successfully broken up by anchoring a line of brush weeds across it.

A floating dike of brush weeds, 1,200 feet long, was run out from the Iowa shore near the head of the old cut-off. The brush weeds used in the dikes built in 1878 were similar to those used at Nebraska City in 1877, described in the annual report for 1878. In 1879, cottonwood saplings in one or more lengths were substituted for the rope core with good results. The system of anchoring was also changed. A rope of proper length was firmly anchored at one end on the line of the proposed dike. To this rope, at proper intervals, the weeds were successively attached and thrown overboard. Each weed had its own anchor as well, but the whole system was connected, thus reducing the total weight of anchorage required, while the weeds could be located with more certainty. The dike thus constructed has, so far, been perfectly successful.

At the head of the revetment heavy cutting went on during the June rise. Some of our work was taken in rear and destroyed, and the erosion is still going on.

During the present season the Iowa revetment will be extended as far as possible, and the work of channel rectification will be continued. To complete the work according to the plan contemplated will require an additional appropriation of \$80,000, which can be profitably expended in one season.

The work is situated in the collection-district of New Orleans, and the nearest port of delivery is Omaha, Nebr. The nearest fort is at Leavenworth, Kans.

Amount of revenue collected at Omaha, Nebr., during fiscal year ending June 30, 1879, was \$2,355.38.

Money statement.

| | | |
|---|-------------|--------------|
| July 1, 1878, amount available | \$80,000 00 | |
| Amount appropriated by act approved March 3, 1879 | 50,000 00 | |
| | | \$130,000 00 |
| July 1, 1879, amount expended during fiscal year | 78,611 09 | |
| July 1, 1879, outstanding liabilities | 11,653 09 | |
| | | 90,264 18 |
| July 1, 1879, amount available | | 39,735 82 |
| Amount (estimated) required for completion of existing project | | 80,000 00 |
| Amount that can be profitably expended in fiscal year ending June 30, 1881. | | 80,000 00 |

O 11.

IMPROVEMENT OF MISSOURI RIVER AT SIOUX CITY, IOWA.

At the date of the last annual report a resurvey at this locality had been ordered. Upon its completion a report and project was submitted to you under date of August 20, 1878. The plan proposed contemplated the protection of that portion of the river front of Sioux City lying below the mouth of Perry Creek, for a distance of about 3,000 feet; also the protection of the bank near Covington, Nebr., directly opposite Sioux City, and other works designed to rectify and confine the channel to the Iowa side of the river. This plan having been approved, work was initiated in the latter part of August, and was prosecuted vigorously until the 15th of October, Assistant S. H. Yonge being in charge of the work. Operations were confined to the Iowa side of the river, where 2,740 feet of bank was protected by brush mattresses extending from low-water mark 40 feet out in the stream. The bank above the mattresses was graded down, and the more exposed portions protected by a layer of fascines 6 inches in thickness. A strong return of the revetment was also built, extending a sufficient distance up Perry Creek to prevent the work being flanked. The mattresses used were composed of layers of willow brush confined between an upper and lower frame of poles, the two frames being connected together by grub pins. After compression, the mattresses measured about 16 inches in thickness. They were built on ways constructed near the upper end of the revetment, and after being launched were floated to position, and sunk by loading them with enough broken stone to carry them to the bottom. The fascines composing the upper bank protection were pinned to the bank by stakes 3 feet long, and were also covered with a light layer of broken stone.

During the winter and after the ice broke up some portions of this work settled, and required repairs, but on the whole it stood well.

Work was resumed April 19, and has been in progress since that time.

A rapid cutting of the Nebraska shore above Covington required immediate attention, and in order to arrest it, a revetment of brush was begun 150 feet up the slough above Covington, and carried around the point and down stream a distance of 300 feet. This revetment extends from high-water mark out into the stream from 40 to 50 feet, and differs from that of last year in being a continuous mat or carpet made by weaving willow brush together. It was first built from the bank alone, but subsequently from the bank and from a boat simultaneously. A similar woven mat was placed on the Iowa side, on the lower 1,000 feet of the old work, extending from high-water mark out far enough to lap over the mattresses that have settled somewhat in this portion of the work. This new work promises to stand well, and will, in the course of the present season, be extended to the mouth of Perry Creek. It is also proposed to build a floating dike outside of the Nebraska Point, to direct the channel from that side of the river to the Sioux City front. This work will exhaust the present appropriation.

To complete the work it is proposed to extend the Iowa revetment from the mouth of Perry Creek to the bluffs above, and to construct 4,050 feet of revetment on the Nebraska shore. It will also be necessary to construct several brush dikes to close subordinate channels and fix the regimen of the river in front of Sioux City. The estimated cost of these

works is \$23,800, which can be profitably expended during the fiscal year ending June 30, 1881.

The work is situated in the collection-district of New Orleans, and the nearest port of delivery is Omaha, Nebr. The nearest fort is at Leavenworth, Kans.

Amount of revenue collected at Omaha, Nebr., during the fiscal year ending June 30, 1879, was \$2,355.38.

Money statement.

| | | |
|---|-------------|-------------|
| July 1, 1878, amount available..... | \$12,500 00 | |
| Amount appropriated by act approved March 3, 1879..... | 10,000 00 | \$22,500 00 |
| July 1, 1879, amount expended during fiscal year | 12,269 71 | |
| July 1, 1879, outstanding liabilities | 3,317 30 | 15,587 01 |
| July 1, 1879, amount available..... | | 6,912 99 |
| Amount (estimated) required for completion of existing project | | 23,800 00 |
| Amount that can be profitably expended in fiscal year ending June 30, 1881. | | 23,800 00 |

O 12.

IMPROVEMENT OF MISSOURI RIVER AT VERMILLION, DAKOTA.

Under date of February 15, 1879, I submitted for your consideration a report of an examination made of this locality. The plan of improvement proposed consisted in revetting the river bank in front of the town of Vermillion, and on both sides of the neck above where a cut-off is threatened. It was also proposed, by means of floating brush dikes, to carry the channel away from Vermillion, restoring it to its old location behind the island opposite the town. The estimated cost of the improvement was \$75,000. Congress, by act approved March 3, 1879, appropriated \$5,000 for carrying on the work. In the project of operations, submitted April 10, 1879, it was proposed to expend this small sum in protecting, as far as possible, the front of the town by brush revetment and floating brush dikes. This plan having been approved, work was begun in the latter part of April, and is still in progress. A revetment composed of a continuous woven brush mat has been constructed along the town front for a distance of 1,125 feet. A floating brush dike, 800 feet long, was also built, and did good service till destroyed by unknown parties. For details of these operations, I beg to refer to the accompanying report of Assistant S. H. Yonge, who had charge of the work.

But little more can be done at this locality during the coming season than to hold and strengthen the revetment already in place, and it is hoped that, if Congress intends to carry on this work, appropriations may be made in some degree commensurate with the estimates. The amount required to complete the work according to the original plan is \$70,000, which amount can profitably be expended in one season.

The work is situated in the collection-district of New Orleans, and the nearest port of delivery is Omaha, Nebr. The nearest fort is at Leavenworth, Kans.

Amount of revenue collected at Omaha, Nebr., during fiscal year ending June 30, 1879, was \$2,355.38.

Money statement.

| | | |
|---|------------|-----------|
| Amount appropriated by act approved March 3, 1879..... | \$5,000 00 | |
| July 1, 1879, amount expended during fiscal year..... | \$1 50 | |
| July 1, 1879, outstanding liabilities | 3,742 15 | 3,743 65 |
| July 1, 1879, amount available | | 1,256 35 |
| Amount (estimated) required for completion of existing project | | 70,000 00 |
| Amount that can be profitably expended in fiscal year ending June 30, 1881. | | 70,000 00 |

REPORT OF MR. SAMUEL H. YONGE, ASSISTANT ENGINEER.

SIOUX CITY, IOWA, June 30, 1879.

MAJOR: By your letter dated April 19, 1879, I was placed in charge of the work of improving the Missouri River at Vermillion, Dak.

I proceeded to that point the latter part of the month, and upon an examination found that the bank below the Vermillion River, for a distance of $\frac{3}{4}$ of a mile, was cutting. With a view to stopping this action, I proposed to divert the main channel of the river from the west to the east side of Vermillion Island by building floating dike No. 2, included in the original project.

Many delays occurring before the necessary preparations could be made, and the time for high-water drawing near, I decided to build the revetment along the town front.

This work was begun May 20 and completed June 6, and extends from the mouth of Vermillion River to a point 1,125 feet below. This revetment consists of a continuous woven mat from 50 to 60 feet wide, and an average thickness of $\frac{3}{4}$ foot. As this system, I believe, has never before been used for bank protection, I herewith submit a description.

The bank was first graded at an angle of about 35° down to the water's edge. Along the face of the slope at high-water mark, and into holes made 6 inches deep with a pointed crowbar, were inserted the butt-ends of pliable willows from $\frac{1}{4}$ inch to 1 inch in diameter. These willows were then bent down and held by the foot of the weaver, each alternate willow lying in the same general direction, and crossing intermediate willows at an angle of 45° . A network was thus formed, through the meshes of which were forced into the ground other willows, which, in turn, formed new meshes through which the next set of willows were stuck. This arrangement being carried down to the water's edge, the buoyancy of the brush and strength of the weaving was sufficient to carry the weight of the workmen over the water. In sticking the willows over the water each willow was passed through and under at least three of the previously-woven meshes. As the weaving progressed the entire length of each willow was woven in, thus forming a compact interlacing of brush, possessing great strength and perfect elasticity. This weaving can be made of any desired thickness; willows of all sizes up to 2 inches diameter and 20 feet long were used. The advantage in this system consists in combining the high and low water protection without break from top to bottom and from end to end, thus avoiding the possibility of any part of the low-water work settling away from the high-water work and leaving a portion of the bank unprotected.

Broken stone was used for sinking the low-water portion of the mat, and for weighting the portion above low-water. The portion of the mat above the water-line was covered with earth to preserve it from the effects of the weather.

When the work was commenced the bank was cutting badly, but this was immediately stopped as the work progressed, the meshes of the mat filling rapidly with sediment.

The total number of square feet covered by this revetment was about 50,000. But one expert weaver was employed; the balance of the labor was unskilled.

The following is a detailed statement of the cost per linear foot:

| STATEMENT. | |
|---------------------|---------|
| Sloping bank | \$0 111 |
| Broken stone | 0 237 |
| Placing stone | 0 101 |
| Brush | 0 631 |
| Weaving | 0 220 |
| Total | 1 30 |

The floating brush dike was commenced on 29th May, and completed by the 14th June to a length of about 800 feet. Where connection was made with the Dakota shore, an apron of woven brush, 40 by 60 feet, was built to prevent any cutting around the shore end of the dike. The weeds were placed at intervals of from 10 to 15 feet, and were buoyed with oil-barrels. The anchors used were at first made of artificial stone, and of mushroom shape; but proving too light, and being unable to procure large flat stone, broken stone in sacks was substituted, and answered the purpose satisfactorily. The amount of stone used per weed for anchoring was from 200 to 1,600 pounds.

During the building of the dike, frequent rises and running drift caused considerable damage, retarding its action and necessitating repairs, thereby increasing the cost.

A very appreciable change in the direction of the current below the dike was noticeable from the time of its completion, all flood wood passing to the east side of Vermillion Island. Steamboats began using the chute on the 16th instant, thus avoiding

the heavy "whirls" in the sharp bend at Vermillion. Deposit of silt, to a depth of 6 to 8 feet, rapidly took place immediately above and below the dike. On Sunday night, the 22d instant, all the barrels of the dike, except five nearest the Dakota shore, were cut adrift by unknown parties. No repairs have since been made, owing to the high state of water.

The total cost of the dike, including repairs, amounted, for labor and material, to 80 cents per linear foot.

During the latter part of the present month a survey was made by my assistants, D. W. Kinnaird and R. P. Lowe, of that portion of the river on which improvements have been made and are contemplated, in the vicinity of Vermillion, Dak., a map of which accompanies this report. It appears from the survey that the Nebraska Neck, at its narrowest point, is only 2,300 feet wide, and the natural slope of the ground from the west to the east side is $3\frac{1}{2}$ feet. The difference of level of water surface on the two sides of the neck at this point is 7.9 feet. The general elevation of the ground on the upper side of the neck is about 5 feet below the extreme high-water of 1857.

In conclusion, I would state that I was ably assisted by Mr. R. P. Lowe, assistant engineer, who was in local charge of the work.

I have the honor to be, very respectfully, your obedient servant,
SAML. H. YONGE,
Assistant Engineer.

Maj. CHAS. R. SUTER,
Corps of Engineers, U. S. A.

O 13.

IMPROVEMENT OF ARKANSAS RIVER BETWEEN FORT SMITH AND WACHITA, KANS.

It is proposed to expend this appropriation in removing snags, rocks, and other obstructions to navigation between the limits designated as soon as the money shall be available. By referring to my report on this portion of the Arkansas River, dated February 5, 1879 (House Ex. Doc. No. 94, Forty-second Congress, third session), it will be seen that \$100,000 will be deemed necessary for carrying on the work immediately needed, and that \$16,300 was recommended for a thorough survey. These recommendations and estimates are respectfully renewed.

The work is situated in the collection-district of New Orleans; the nearest port of delivery is Memphis, Tenn., and the nearest fort is Fort Smith, Ark.

The amount of revenue collected at Memphis, Tenn., during fiscal year ending June 30, 1879, was \$17,035.23.

Money statement.

| | |
|--|-------------|
| Amount appropriated by act approved March 3, 1879 | \$20,000 00 |
| July 1, 1879, amount available | 20,000 00 |
| Amount (estimated) required for completion of existing project | 96,300 00 |
| Amount that can be profitably expended in fiscal year ending June 30, 1881 | 96,300 00 |

O 14.

IMPROVEMENT OF ARKANSAS RIVER AT FORT SMITH, ARKANSAS.

On August 19 work was resumed on the dike built in the Arkansas River at this point. It was found that considerable settlement had taken place in that portion of the work which crossed the original location of the main channel. The damage was repaired and the work was brought up to a uniform height of 8 feet above low-water, the width being increased to 40 feet. The slant was lengthened 400 feet, making

it 1,000 feet long, and the spur-dike being 1,100 feet long. The total length of dike is 2,100 feet. Work was closed at the end of October. Recent examinations show that the object sought has been successfully accomplished, as the channel now crosses from the Fort Smith side below Garrison avenue, giving free access to the town landing and a good ferry crossing. The dike itself stands well, and no further extension is thought to be necessary.

This work is situated in the collection-district of New Orleans. The nearest port of delivery is Memphis, Tenn., and the nearest fort is Fort Smith, Ark.

The amount of revenue collected at Memphis, Tenn., during fiscal year ending June 30, 1879, was \$17,035.23.

Money statement.

| | |
|---|-------------|
| July 1, 1878, amount available..... | \$10,000 00 |
| July 1, 1879, amount expended during fiscal year..... | \$9,977 65 |
| July 1, 1879, outstanding liabilities..... | 22 35 |
| | <hr/> |
| | 10,000 00 |

O 15.

IMPROVEMENT OF WHITE RIVER AT BUFFALO SHOALS, ARKANSAS.

At the date of the last annual report a party was at work at this locality engaged in the removal of loose rock from the channel. These operations were kept up until the small balance remaining was exhausted, when no further appropriation having been made work was suspended, leaving the improvement incomplete. On October 24, 1878, in accordance with your orders, the work was turned over to Capt. W. H. H. Benyaurd, Corps of Engineers, U. S. A.

Money statement.

| | |
|---|------------|
| July 1, 1878, amount available..... | \$1,676 50 |
| July 1, 1879, amount expended during fiscal year..... | 1,676 50 |

O 16.

SURVEY OF MISSOURI RIVER FROM ITS MOUTH TO SIOUX CITY, IOWA.

In my last annual report it was stated that the appropriation then available for this work would be expended on the survey of that portion of the river lying between the mouth and Leavenworth, Kans.

In accordance with this programme a party was organized under the charge of Assistant D. W. Wellman, and after procuring the necessary outfit of instruments, quarter-boats, skiffs, &c., work was begun August 24, 1878, at the town of Weston, Mo., 5 miles above Leavenworth. From this point the survey was pushed rapidly downstream, reaching Boonville, Mo., 217 miles from the starting point, December 4, 1878, when the field-work was suspended for the winter, with the exception of short local surveys at Cedar City and Saint Charles, Mo. During the winter the field-notes were plotted, and April 7, 1879, the active work of the survey was again taken up. Leaving Boonville on this date, the mouth of the river, 193 miles distant, was reached May 21. The party was at once transferred to Sioux City, Iowa, to complete the upper por-

tion of the work. June 6 the survey began 3 miles above the Big Sioux River, and on the 30th was 5 miles below the Little Sioux, having progressed 80 miles. The total season's work, therefore, covers 490 miles. The survey is based upon a triangulation carried along the banks. The hydrography and topography of the shores, islands, and bars is complete, and the topography of the valley on both sides is determined, though with less detail.

During the present season it is proposed to complete the survey to Weston, the initial point of last year, the distance being about 300 miles.

By act of Congress, approved March 3, 1879, the head of the survey is carried from Sioux City to Fort Benton. I have estimated the cost of this extension at \$100,000, and the time required for its completion at three years. For the first year \$50,000 is asked.

Money statement.

| | |
|---|-------------|
| July 1, 1878, amount available..... | \$50,000 00 |
| Amount appropriated by act approved March 3, 1879..... | 30,000 00 |
| | <hr/> |
| | \$80,000 00 |
| July 1, 1879, amount expended during fiscal year..... | 44,374 19 |
| July 1, 1879, outstanding liabilities..... | 15,354 19 |
| | <hr/> |
| | 59,728 38 |
| July 1, 1879, amount available..... | 20,271 62 |
| | <hr/> |
| Amount (estimated) required for completion of existing project..... | 100,000 00 |
| Amount that can be profitably expended in fiscal year ending June 30, 1881. | 50,000 00 |

O 17.

IMPROVEMENT OF MISSOURI RIVER AT SAINT CHARLES, MISSOURI.

A report, with plan and estimate for the improvement of the Missouri River at this point, was submitted to you under date of January 2, 1879, and was published in House Ex. Doc. No. 60, Forty-fifth Congress, third session. Congress having failed to make any appropriation for this important work, the estimate of \$80,000 is respectfully renewed.

SURVEY OF THE MISSOURI RIVER IN THE VICINITY OF SAINT CHARLES, MISSOURI.

UNITED STATES ENGINEER OFFICE,
Saint Louis, Mo., January 2, 1879.

GENERAL: I have the honor to inclose herewith a report of my assistant, Capt. Thomas H. Handbury, Corps of Engineers, United States Army, on the Missouri River in the vicinity of Saint Charles, Mo. This report, with accompanying map, gives the details of the present situation of affairs and the plan of improvement proposed.

In considering the subject attention has been confined to that portion of the river above the railroad-bridge, as this structure is in great danger, and the need of work here is more pressing than it is below.

The plan proposed is torevet with brush mattresses the bank, which is exposed to erosion, and then to attempt the rectification of the river

by a series of floating brush dikes similar in general plan to the work carried on and proposed at other places along the Missouri River.

The total estimate of the work is \$80,000, which can profitably be expended in one season. The whole sum should be appropriated at once in order to avoid delays in carrying the work to completion.

I am, general, very respectfully, your obedient servant,

CHAS. R. SUTER,
Major of Engineers.

Brig. Gen. A. A. HUMPHREYS,
Chief of Engineers, U. S. A.

REPORT OF CAPTAIN THOMAS H. HANDBURY, CORPS ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Saint Louis, Mo., January 20, 1879.

MAJOR: In obedience to your instructions received a few days since, I have prepared a plan and estimate for the improvement of the navigation of the Missouri River, and for the protection of property from its encroachments in the vicinity of Saint Charles, Mo. Upon this plan and estimate I have the honor to report as follows:

In making my study of the problem which the improvement of the Missouri River in this locality presents, I have been materially aided by the map and report of the special survey of the Missouri River at Saint Charles, recently submitted to you by your assistant, Mr. D. W. Wellman.

From the information that is embodied in these, as well as that gleaned from other sources, we see that marked changes are taking place here, which are of such a nature that they have already caused the destruction of much valuable property, and will, if not arrested at an early day, destroy other that is more valuable still.

For convenience I have caused the map submitted by Assistant Wellman to be reduced, and have marked upon this reduced map the position of the works which I propose for remedying the evils existing here. A tracing of this I herewith inclose.

The most marked of the changes that are referred to above, are those which have taken place in the bend, immediately above the Saint Charles Bridge, and also in the left bank, about 3 miles below. In my project I have not taken cognizance of this latter locality, for the reason that it is thought that, unless specially so directed, interests which are more of a private nature than a public, had better await consideration until such a time as the general subject of the rectification of the Missouri River and the improvement of its navigation comes up for consideration.

In the bend above, the interests at stake are more of a public nature, affecting the community at large, in this, that the railway-bridge, which is here the object of especial solicitude, is a great public convenience, the destruction of which would be felt throughout all the communities where the roads passing over it are of importance.

From an inspection of the map we see that the erosion in this bend since 1868 has been enormous, and judging from the amount that took place between April, 1878, the date of a survey made by the Kansas City and Northern Railway, and December 14, 1878, the date of Assistant Wellman's survey, it appears that the rate of this erosion has not materially diminished.

Since 1868 the right bank of the river in this bend has advanced towards the southern approaches to the bridge about 3,000 feet. If the forces that are now at work here are allowed to continue as at present, they will certainly effect the destruction of the bridge, or at least its usefulness, by causing the river to pass around its southern end. While the danger here is very great, the means of averting it, it seems to me, are very simple.

The channel in 1868 seems to have been over against Saint Charles Island, in what now is a series of sloughs, but by reason of the bar on the right bank above moving down and crowding the current against the shore just above the head of the island, this was washed away.

This gave such a direction to the current as it crossed to the other side that it brought it forcibly against the other bank, which, being of lighter materials, was eroded with the result as we have it shown upon the map. The remedy that I propose in this case is to make the shore on both sides take some such shapes as are indicated by the broken lines ————. The first thing to be done will be to stop the erosion of the bank where it is now taking place in the bend above, from near the outlet of the first small stream down to the head of the slough, a distance of about

7,000 feet, and in the bed below the right bank from where the river approaches nearest the bluff down to the bridge, a distance of about 15,000 feet. After this is done I would place such obstructions in these bends as would check the velocity of the current and cause deposits to take place in them, which would gradually build out the shore and at the same time crowd the channel to the sides opposite.

In the upper bend this would have the effect to wash away the bar that is now crowding the river to the left bank and let the river into the bend below in an easier curve, while in this lower bend like obstructions would cause deposits to be formed, resulting in the washing away of the bar opposite them.

These revetments and obstructions I would make of brush, and in a manner similar to that recommended in my project for the improvement of the Missouri River at Glasgow, Mo., submitted to you on the 16th instant.

For this work I estimated as follows:

| | |
|---|----------|
| To 23,000 feet brush revetment, at \$2.25 per foot | \$51,750 |
| To 18,000 feet floating brush dike, at \$1 per foot | 18,000 |
| Contingencies and superintendence | 10,250 |
| Total | 80,000 |

Respectfully submitted,

THOS. H. HANDBURY,
Captain, Corps of Engineers.

Maj. CHARLES R. SUTER,
Corps of Engineers, U. S. A.

O 18.

EXAMINATION OF ARKANSAS RIVER, FROM FORT SMITH, ARKANSAS, TO THE MOUTH OF LITTLE ARKANSAS.

UNITED STATES ENGINEER OFFICE,
Saint Louis, Mo., February 5, 1879.

GENERAL: In accordance with your instructions of July 8, 1878, I have caused a reconnaissance to be made by Mr. J. D. McKown, assistant engineer, of the Arkansas River from the mouth of the Little Arkansas to Fort Smith, and a copy of his report thereon is herewith submitted.

Owing to the very small sum allotted to this work, only a hurried reconnaissance was possible, but a good idea was obtained of the character of the river and its capacity for improvement.

The whole length reported on is about 409 miles, of which the upper portion, 70 miles long, affords a low-water depth over the numerous sand bars of about 6 inches. The remaining portion has a navigable low-water depth of about 12 inches, but the channel is much obstructed by snags. There are also some localities where the removal of rock would be necessary.

In addition to the natural obstructions there are three bridges unprovided with draws, and of course impassable for steamers.

Except in the upper portion before mentioned, the navigable low-water depth is about the same as that of the Arkansas River between Little Rock and Fort Smith, and it would of course be useless to attempt to get a greater depth until the balance of the stream was correspondingly improved.

The estimates presented by Assistant McKown are for removing snags and rocks and so contracting the width of the stream as to give at low-water a depth of about 2 feet, but this estimate is only a rough approximation at the best, and no work on this scale should be undertaken, even if deemed advisable, until a thorough survey of the stream has been made, the cost of which is estimated at \$16,360.