

APPENDIX O.

ANNUAL REPORT OF MAJOR CHARLES R. SUTER, CORPS  
OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE  
30, 1879.

UNITED STATES ENGINEER OFFICE,  
*Saint Louis, Mo., September 24, 1879.*

GENERAL: I have the honor to submit herewith my annual report upon the operations committed to my charge during the fiscal year ending June 30, 1879.

I am, general, very respectfully, your obedient servant,  
CHAS. R. SUTER,  
*Major of Engineers.*

Brig. Gen. H. G. WRIGHT,  
*Chief of Engineers, U. S. A.*

O I.

REMOVING SNAGS AND WRECKS FROM THE MISSISSIPPI, MISSOURI, AND  
ARKANSAS RIVERS.

The field work during the past year has been confined to the operations of the only two boats available for the purpose, the snagboats Macomb and De Russy. The extreme heat of the summer and the prevalence of the yellow fever followed by a winter of unusual severity, as well as the generally low stage of the tributaries, prevented us from accomplishing very much work, except on the Mississippi where the wants of navigation were fairly met. On this stream seven months' snagboat work was accomplished, while the Missouri received four months'. Nothing was done on the Arkansas, owing to the low stage of water, which would not admit of the entrance of any of our boats.

MISSISSIPPI RIVER.

Work on this stream extended from Vicksburg, Miss., to the mouth of the Missouri, and covered a period of seven months, the work being done by the snagboats Macomb and De Russy.

The snagboat Macomb left Mound City, Ill., August 1, and worked up to Saint Louis August 10; she was assigned to the Missouri River. She returned to the Mississippi November 1, and worked down to Vicksburg; which point was reached December 23. She then worked up again to Saint Louis, reaching that point March 14, and then worked down to Cairo; and was laid up at Mound City March 19.

The *De Russy*, after being extensively repaired, left Mound City, Ill., September 24. She worked for about two months between Cairo and Saint Louis, making four trips over the ground, and was finally laid up at Mound City November 13.

Table of work done in the Mississippi River.

Name of boat.	Number of snags pulled.	Weight in tons of 2,000 pounds.	Number of trees cut.	Number of drift piles removed.	Number of miles run.
R. E. De Russy.....	369	5,641.5	528	.....	806
J. N. Macomb.....	764	10,286.4	2,162	5	1,934
Total.....	1,133	15,927.9	2,690	5	2,740

## MISSOURI RIVER.

The snagboat Macomb entered this river August 10, and worked up to Kansas City, which point was reached September 12. By September 26, she had worked down to Saint Louis, and immediately started back on a second trip. Low-water obliged her to turn back from Sandy Hook Bar October 21, and on November 1 she had reached Saint Louis and was assigned to the Mississippi River.

Table of work done in the Missouri River.

Name of boat.	Number of snags pulled.	Weight in tons of 2,000 pounds.	Number of trees cut.	Number of drift piles removed.	Number of miles run.
J. N. Macomb.....	876	10,995.2	258	30	1,464

Recapitulation of work done during the fiscal year ending June 30, 1879.

Name of river.	Number of snags pulled.	Weight in tons of 2,000 pounds.	Number of trees cut.	Number of drift piles removed.	Number of miles run.
Mississippi River.....	1,133	15,927.9	2,690	5	2,740
Missouri River.....	876	10,995.2	258	30	1,464
Total.....	2,009	26,923.1	2,948	35	4,204

## OBSERVATIONS AND SURVEYS.

Under the instructions of the department, surveys were made and observations kept up at Saint Charles, Mo., Pine Bluff, Ark., Columbus, Ky., Point Pleasant, Mo., Osceola, Ark., Choctaw Bend, Miss., and Lake Providence, La. The steamer Octavia has been used in connection with this work for purposes of inspection, surveys, and supply.

## CONSTRUCTION OF NEW SNAGBOATS.

Iron hulls to carry the machinery of two of the old wooden boats were commenced last summer. They are well advanced towards completion and it is expected that the machinery will be on board and the boats ready for the field before the end of the present summer. It is still thought necessary to rebuild one wooden snagboat, and to repair another and fit her up for the removal of wrecks.

## OPERATIONS FOR THE COMING SEASON.

The plans submitted to you contemplate completing the two boats now in process of construction, in completing the surveys and observa-

tions ordered, and in carrying on such snagboat work as may be needed. Thirteen months' work is contemplated, distributed as follows, viz:

	Months.
Mississippi River.....	6
Missouri River.....	4
Arkansas River.....	3
Total.....	13

The work is situated in the collection-district of New Orleans. The amount of revenue collected at the port of Saint Louis, Mo., during the fiscal year ending June 30, 1879, was \$1,136,417.85.

The commerce benefited by the work is that of the entire Mississippi Valley.

## ESTIMATE OF AMOUNT REQUIRED FOR FISCAL YEAR ENDING JUNE 30, 1881.

For building one small iron-hulled snagboat to carry machinery of one of present wooden boats.....	\$105,000
For repairing one wooden snagboat and fitting it up for wrecking purposes.....	50,000
For working expenses of 5 boats, ten months each, at \$4,000 per month....	200,000
Total.....	355,000

## Money statement.

July 1, 1878, amount available.....	\$250,137 35
Amount appropriated by act approved March 3, 1879.....	190,000 00
	\$440,137 35
July 1, 1879, amount expended during fiscal year.....	216,013 51
July 1, 1879, outstanding liabilities.....	70,292 78
	286,306 29
July 1, 1879, amount available.....	153,831 06
Amount that can be profitably expended in fiscal year ending June 30, 1881.	355,000 00

O 2.

## IMPROVEMENTS ON THE MISSOURI RIVER.

When work upon this river was first undertaken by the government in the summer of 1877 there was available but little practical experience upon streams of such erratic and treacherous nature. The works which private parties had built on the Missouri had generally failed, either through faulty design or lack of proper extension; or, if successful, their great cost prohibited their adoption on a large scale. I was convinced that the accomplishment of any desirable improvement by means of massive revetments and dikes was prohibited by its cost, as they could not be expected to stand on such treacherous foundations as the bed of the river afforded, but would certainly settle until they reached the bed-rock, often 60 or 70 feet below low-water mark. In addition to this palpable disadvantage, the time required for the construction of such work would generally render it inoperative in securing desired results, as the extreme rapidity with which changes in the river regimen are constantly occurring renders promptness in execution essential. I therefore decided that it was expedient to adopt systems of construction which should be yielding and elastic in their nature, opposing only sufficient resistance to the current to check its velocity and induce a deposit of the transported sediment, the expectation being that the deposits thus formed

would be sufficiently large and stable to effect the changes in regimen deemed desirable. To secure banks from erosion it was decided to adopt some form of brush mattress which would accumulate in its meshes sufficient sand and silt to keep it in place, and by preventing the direct impact of the current upon the banks enable them to resist the encroachments of the river. By extending the works over a sufficient distance, it was hoped that a stable regimen might be obtained which would give an improved navigation and security to land and property along the river. Work done in 1877 was mainly experimental, but the results obtained were sufficiently encouraging to warrant a continuance of the methods employed. During the past season the liberal appropriations enabled us to experiment on a large scale, and no means were spared to reach a method of bank protection which should combine the greatest efficiency with the least cost. Different styles of construction were used on the various works, and different dimensions and thickness of mattresses were tried. Generally they were built on ways constructed on the shore, whence they were launched and floated to their destined position, being finally sunk against the bank by a moderate amount of stone. There are many drawbacks to this method, and to obviate them at Nebraska City the mattresses were built on floating ways at the precise point where they were to be used. A good bond with the bank could thus be obtained, and the mattress being loaded while on the ways went directly to the bottom when launched. Our experience shows that a thin mattress, not greatly exceeding 6 inches, is better than a thicker one, while, of course, cheaper; that tenacity and flexibility are essential to enable it to fit the bank closely; that no more ballast should be put on than is sufficient to sink it; and that, as long as it cannot be undermined or flanked, it is a permanent protection to the bank. The work of 1878 consisted entirely of lines of separate mattresses of various sizes; but this year we shall experiment on continuous mattresses of different kinds, as this system is deemed to have many points of advantage. One plan already tried is described in the report on Vermillion, Dakota. Contrary to general expectation, no damage was done to the work by the breaking up of the ice, but during the spring and summer rises some weak points were developed. Fortunately, no great damage was done, but much valuable experience was gained. My conviction has been also strengthened that it will always be necessary to embrace in these projects for improvement a long enough reach of river to insure favorable direction to the currents, which should flow *along* the protected banks and not impinge directly against them. When this latter condition occurs, the eddies set up scour deep below the normal position of the bed, and the bank protection is undermined, and requires extension till the limit of scour is reached. Work last season was begun so late that only mattress-work could be done to advantage, as the various silt-catching devices operate best at high-water, when the amount of material moved is at its maximum. During 1879, however, the conditions have been favorable and many experiments have been tried. The results obtained have been very satisfactory, but the subject is still too experimental to warrant a lengthy description of methods tried. The object of the work has been already adverted to. It is designed by inducing deposit to build up bars at selected localities, which bars will eventually be sufficient to turn the river channel in the desired direction, while at the same time confining and contracting the water-way. When these artificial shores have attained the proper dimensions they will be secured by revetments where necessary. In this manner, by utilizing the natural forces at work, we

hope to avoid any direct conflict with the river, as in such a conflict we should in all probability be worsted.

During the coming season all these interesting studies and experiments will be continued, and I have now strong hopes that they will develop cheap and efficient methods of improvement which will be of great benefit to the vast interests involved.

In carrying on work of this character, it is extremely important that funds should be available whenever needed, and this of course requires liberal appropriations. Changes in the river regimen, whether detrimental or beneficial, occur with such extreme rapidity, that they must be met with equal promptness, and, moreover, no work done can be considered safe until the entire scheme is carried out. It is therefore certain that ultimate success must depend upon the liberality of the appropriations. If the sums estimated as necessary are promptly furnished, the work can probably be done cheaply and efficiently, but if they are not, then an indefinite increase in the cost of the work and even ultimate failure will often be unavoidable.

In carrying on these works, I have allowed my assistants great latitude in the choice of means to secure the desired end, and to their zeal and intelligence the good results obtained are mainly due. All the works on the Missouri River have been under the immediate supervision of my assistant, Capt. Thomas H. Handbury, Corps of Engineers, U. S. A.

## O 3.

## IMPROVEMENT OF THE MISSOURI RIVER AT CEDAR CITY, MISSOURI.

A report, with plan and estimate for the improvement of the Missouri River at this point, was forwarded to you under date of January 18, 1879, and was published in House Ex. Doc. No. 44, Forty-fifth Congress, third session. Congress having appropriated \$10,000 for carrying on this work by act approved March 3, 1879, operations under the general plan were commenced May 20, and are still in progress, Assistant S. Waters Fox being in charge, with Assistant T. C. Bradley as local engineer. Work has been in progress on a mattress revetment along the east bank of Cedar Creek and the town front of Cedar City, also upon a floating brush dike located above the creek, and forming part of the general scheme of channel rectification. These operations will be continued till the funds available are exhausted. For the completion of the work \$60,000 is asked for, which can profitably be expended in one season.

This work is situated in the collection district of New Orleans, and the nearest port of delivery is Saint Louis, Mo.

The nearest fort is at Leavenworth, Kans.

Amount of revenue collected at the port of Saint Louis, Mo., during the fiscal year ending June 30, 1879, was \$1,136,417.85.

*Money statement.*

Amount appropriated by act approved March 3, 1879.....	\$10,000 00
July 1, 1879, amount expended during fiscal year.....	2 00
July 1, 1879, outstanding liabilities.....	3,681 40
	3,683 40
July 1, 1879, amount available.....	6,316 60
Amount (estimated) required for completion of existing project.....	60,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881.	60,000 00

SURVEY OF THE MISSOURI RIVER AT CEDAR CITY, MISSOURI.

UNITED STATES ENGINEER OFFICE,  
Saint Louis, Mo., January 18, 1878.

GENERAL: I beg leave to submit herewith a copy of a report by my assistant, Capt. Thos. H. Handbury, Corps of Engineers, U. S. A., upon the Missouri River in the vicinity of Cedar City, Mo.

I beg to refer to this report and accompanying map for a description of the locality and the damage which has resulted from the erosion of the banks, as also for the details of the plan of improvement projected. It is proposed to attempt the rectification of the river in this vicinity by a system of floating brush dikes, the exposed banks being protected by a revetment of brush mattresses, as used with success at other points along the river. The estimate for the whole work is \$70,000, and 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.

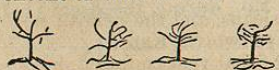
REPORT OF CAPTAIN THOMAS H. HANDBURY, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,  
Saint Louis, Mo., January 18, 1879.

MAJOR: I have the honor to submit the following project, prepared in obedience to your instructions, received a few days since, for the improvement of the navigation of the Missouri River and for the protection of property from the incursions of the river in the vicinity of Cedar City, Mo.

For the purpose of placing in as clear a light as possible what I have to say in regard to this locality and the project I shall propose, I submit herewith a tracing of a map of this portion of the Missouri River, the original of which on a large scale, together with a report, was recently submitted to you by your assistant, D. W. Wellman. From this map and report we have the means of comparing in its general features the condition of the river as it was some years since and as it exists at the present time.

We see that as late as 1861 the river passed in an almost straight course along the foot of the bluffs which form its right bank. Its left bank at that time was nearly parallel to this. For some reason, which it is not necessary now to consider, the channel in the upper part of the reach, represented upon the map, began to wear away the left bank. This caused the bend of the river to move down, filling in on the right bank as the left was worn away. This process soon changed the direction of the current and brought it against a point of rocks which is on the right bank of the river about 3 miles above Jefferson City. From here, instead of pursuing its old course down along the edge of the bluffs, it was deflected back to the left bank with such force as to cause rapid erosion, which resulted in the formation of a bend about a mile above Cedar City. As time progressed the erosion went on, and the point of impact in this bend moved rapidly down, threatening the entire town with destruction. To prevent this calamity the citizens of the town and county exerted themselves to the extent of their means.



In 1875 they built out in the position marked thus upon the map a floating brush dike, made by taking trees as large as could be handled with a derrick and loaded upon a flatboat, and anchoring them close together; the idea in this being to build out a bar from the left bank and deflect the current so as to get it out of the bend. Unfortunately their means were limited, and they were obliged to cease the good work before they had carried it sufficiently far to accomplish their object. The result was that a bar followed the dike out as they had anticipated, but the point of impact in the bend was moved down to somewhere in the neighborhood of the mouth of Cedar Creek. Here the citizens again exerted themselves, and built in 1876 a riprap of stone and brush, which, after giving away two or three times and being as often repaired, is now holding the bank at this point.

Now, what is needed in this locality is to relieve the left bank of the river here of the current entirely and get it back to the bluff on the other side. We can scarcely

expect, under existing circumstances, to get the river back throughout this entire extent to where it was before; but we can, I think, without difficulty, relieve the left bank of the current, fill up the bend above Cedar City again, and provide for the maintenance of a good steamboat landing at Jefferson City. This I would propose to do by rectifying the shore into some such a shape as that indicated by the line marked thus . . . upon the map.

At the upper end of the reach between A and B I would allow the erosion to go on until the shore assumed about the shape indicated by the dotted line between these two points; then I would hold it there by a revetment. While the erosion is taking place here, I would prevent it between B and C by revetting. This would cause the current to impinge against the right bank higher up than it now does, and, as a consequence, give it a direction from there more nearly parallel to the bluff. From D to E I would propose a continuous revetment, so as to hold all this portion of the shore. In addition, to keep the current away from this shore, and at the same time to crowd the channel over toward the right bank by building out the left, I would use a series of dikes, somewhat as indicated upon the map. Somewhere in the vicinity of E I would place a dike, with a view of throwing the current from here over to the right bank, so as to give this portion of Jefferson City a good steamboat landing at all stages of the river. These revetments and dikes I would construct of brush, as indicated in my project for the improvement of the Missouri River at Glasgow, submitted to you on the 16th instant.

The estimate I make for this work is as follows:

For 20,000 feet of brush revetment, at \$2.25 per foot .....	\$45,000
For 15,000 feet floating brush dike, at \$1 per foot .....	15,000
Contingencies and superintendence .....	10,000
Total .....	70,000

Respectfully submitted.

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

THOS. H. HANDBURY,  
Captain Corps of Engineers.

O 4.

IMPROVEMENT OF THE MISSOURI RIVER AT GLASGOW, MISSOURI.

A report, with plan and estimate for the improvement of the river at this locality, was submitted to you under date of January 18, 1879, and was published in House Ex. Doc. No. 46, Forty-fifth Congress, third session. Congress, by act approved March 3, 1879, appropriated \$15,000 for carrying on this work, and operations under the general plan proposed were begun May 12, and are still in progress, Assistant S. Waters Fox being in charge. Operations have been confined to the construction of floating brush dikes, designed to remove the channel from the right bank in the bend immediately above Glasgow, Mo. Some 4,000 feet of dike has been built and has given satisfactory results. During the season this work will be prosecuted to the extent of the available appropriation. For completing the work \$118,000 is asked for, 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 Saint Louis, Mo. The nearest fort is at Leavenworth, Kans.

Amount of revenue collected at Saint Louis, Mo., during fiscal year ending June 30, 1879, was \$1,136,417.85.

Money statement.

Amount appropriated by act approved March 3, 1879 .....	\$15,000 00
July 1, 1879, amount expended during fiscal year .....	205 72
July 1, 1879, outstanding liabilities .....	5,152 04
	<hr/>
	5,357 76
July 1, 1879, amount available .....	9,642 24
	<hr/>
Amount (estimated) required for completion of existing project .....	118,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881 .....	118,000 00

## SURVEY OF MISSOURI RIVER IN THE VICINITY OF GLASGOW, MISSOURI.

UNITED STATES ENGINEER OFFICE,  
Saint Louis, Mo., January 18, 1879.

GENERAL: I beg leave to inclose herewith a copy of a report by my assistant, Capt. Thomas H. Handbury, Corps of Engineers, upon the Missouri River in the vicinity of Glasgow, Mo.

This report, with the accompanying map, sets forth with clearness the situation of affairs at that locality, together with the plan of improvement proposed, viz, of rectifying the course of the river by a system of floating brush dikes, and holding all portions of the bank exposed to injurious scour by brush mattresses, as used by us at other points along the Missouri River.

The estimates for the work, which is approved by me, aggregate \$133,000, which could be expended in one season, and the money should be appropriated at once, as the condition of affairs will not admit of delay.

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 OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,  
Saint Louis, Mo., January 16, 1879.

MAJOR: I have the honor to submit the following project, prepared in obedience to your instructions, received on the 10th instant, for the improvement of the navigation of the Missouri River in the vicinity of Glasgow, Mo., and also for the protection of valuable property in the same vicinity that is in danger of being totally destroyed because of a change in the regimen of the river.

Before entering upon the details of the project, a few words in explanation of the condition of the river in this locality and of the causes which gave rise to the necessity for the project would probably conduce much to a clearer understanding of the case.

From the map of this vicinity, which has recently been submitted to you by your assistant, D. W. Wellman, and the report which accompanies it, it is seen that alarming changes, which require immediate attention, are in progress here. A reduced copy of the map submitted by Assistant Wellman I inclose herewith, with the plan of the work of improvement proposed marked thereon.

Those changes to which our attention is especially directed are all within the reach between the site of the Glasgow Bridge and the upper end of Cambridge Bend. The dotted lines, showing the position of the shore as it existed some years since, were taken from the most reliable local and land-office surveys that could be obtained. At best they are only approximate, but they show enough to indicate in a general way how the changes are taking place and where we should direct our efforts to arrest them, and if possible restore the old and more satisfactory condition of affairs.

Commencing at the upper end of the portion of the river that is under consideration, we see that formerly the main body of the water of the river passed down along the right bank until it reached the lower end of the bluffs, giving a good steamboat landing in front of the town of Cambridge. Here it separated into two portions, one passing to the north of Harrison's Island, and the other to the south around a gradual bend, at the lower end of which the two portions joined and then proceeded in a well-defined channel around the point, upon which are projected the eastern approaches of the Glasgow Bridge.

This state of affairs was very favorable, and the interests of the locality adjusted themselves to it; but in the process of those frequent and rapid changes which are characteristic of the Missouri River it could not be of indefinite duration. Conditions were introduced which have resulted in a change in the regimen of the river, involving the destruction of valuable farms, important commercial interests, and threatens still greater.

Whether the cause of these changes lies within the reach under consideration, above it, or below it would be difficult to determine. Suffice it, however, that from some cause the river has left its old channel on the right bank in the bend above Cambridge, and has gone over to the left bank, which it is rapidly eroding. Between its old channel and its new an island has been formed. The old channel is now a high-water chute, which is silting up with the heavier materials brought down by the river.

With the washing away of the left bank the direction of the main current of course changes. It is now against the right bank, about  $1\frac{1}{2}$  miles below Cambridge. Here the bank is being eroded very rapidly, and as this takes place a bend is formed which deflects the water over against Harrison's Island, but meeting here with material which offers some resistance to its erosive action, it is deflected back toward the right bank, having washed for itself two channels through the sand-bars that have formed in this large bend.

There is still some water passing down the south side of the island, but the indications are that this will soon silt up so as to leave only a high-water chute, if the present forces that are at work are allowed to continue.

The water that returns to the right bank impinges against it with the most disastrous effect. It is here that the most vital interests are threatened, being nothing less than cutting through the eastern approaches of the Glasgow Bridge, and placing the town of Glasgow, which is now beautifully located upon the bank of the river, some 2 or 3 miles from it.

This danger is aggravated so long as the channels on either side of Harrison's Island are used as high-water outlets for the river. While this is the case, the heavier sediment carried by the river at its flood stages will be deposited in the vicinity of the foot of the island, which will have the effect of crowding the main body of the river against the right bank, and thus increasing the erosion of that bank.

As a temporary expedient for checking erosion in this bend, where it is threatening the track of the Chicago and Alton Railway, their engineer has put in a short dike made of brush and sand, which, for the present, is having the desired effect.

This then, in brief, is the condition of affairs as they were in this locality some years ago and as they exist at present.

The present outlook is certainly not very pleasing to contemplate. In applying a remedy to the existing evils, the most obvious method which suggests itself is the one that has for its object the restoration of the river, as nearly as possible, to its old and more satisfactory regimen, or the rectification of its banks to something like their former condition.

If these banks can be made to assume some such positions as are indicated by the broken lines... upon the accompanying map and be held in those positions, the desired object will be attained. To do this, in the first place, the erosion of the banks must be stopped, then such works must be placed outside of these eroded portions as will force the channel away from them and cause accretions in their front. All contemplated works of improvement should point to this end.

To stop the erosion of the banks, I would propose that they be revetted with mattresses made of brush fastened together with poles and wire. These should be from 40 to 60 feet square and about 12 inches thick. The banks should be graded to a slope a little less than the natural slope of the earth under the conditions in which it would be found, and the mattresses placed upon it in juxtaposition throughout the entire extent to be protected. They should reach from the edge of the water at the time they were put in place down the slope to its foot, and out along the bed of the river for some 30 or 40 feet, or so far that, should a scour take place under the outer edge of them, they will have sufficient extent when folded back into the hole to still protect the bank.

Such a revetment as this can be put in for about \$2 per linear foot. This estimate, as well as the others which are to follow in this report, is based upon the experience gained during last season in the several works of improvement of the Missouri River under your charge.

To protect that part of the bank which is between the inner edge of these mattresses and the high-water line, I would first cause it to be graded to a slope of about 1 on 2, and then cover it with willow brush 3 or 4 inches thick, held down by wire and pegs. This revetment in place will cost about 25 cents per linear foot. The total revetment will thus be \$2.25 per foot of banks. These revetments, in order to produce the desired effect and to be done with economy, should be put in during a low stage of water. With regard to the accretions that it is desirable to accumulate in front of these revetments or at any particular place in the river, we have only to bear in mind the well-known feature of the Missouri River.

Every day there are immense quantities of material, such as will answer our purpose, floating and rolling by just when we desire to have it. It is only a question how we can induce it to stop. This I would propose to do by making floating obstructions or brush dikes, which will check the current and cause a deposit to take place