IMPROVEMENT OF THE SOUTH PASS OF THE
MISSISSIPPI.¹

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In regard to the depth of channel that exists at present through the jetties, it will be sufficient to state that on the first day of November, this year, the steamship *City of Bristol*, of the New York and Liverpool Inman Line, passed through the jetties without detention and without touching. Her draught was 21 feet and 8 inches, the tide at the time was $2\frac{1}{2}$ inches below "average flood tide," which is the plane of reference established by the United States Engineers.

It may not be generally understood that the delay in obtaining the deeper channels, demanded by the contract between Capt. Eads and the United States Government, has been caused mainly by the difficulties which have been met with in deepening the river shoal at the head of the Passes.

First, there was not a full knowledge and comprehension of all the conditions existing, nor of their relation to each other, and to the channel, which it was necessary to make into South Pass; secondly, it was necessary that the works should be partly tentative in their nature, and this fact demanded considerable time in which to observe their effects; thirdly, many months were consumed in building these extensive works which would control the whole volume of the river. All these causes have delayed the formation of the channels through the bar at the Gulf, where the jetties are located. Without entering, beyond a few explanations, into the discussion of this most difficult and interesting problem of river hydraulics, on which a treatise could well be written, we simply refer to the fact of its existence and of its intimate relation to the channel through the jetties.

There are conditions existing of so subtle a nature, with relations so obscure, and yet so entirely dependent upon each other; there are hidden causes, that operate so quietly and easily, to change existing conditions and destroy the equilibrium of natural forces; there are at times such unlooked-for results from the works constructed, and there are so many occult principles and unknown laws in the flow of water moving in immense volumes that are elucidated by these results, that, in the end, one of the most useful and interesting histories may be

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written, that will record in detail all the steps which have been taken to persuade the water of the great river to go where man directs.

With all the interest that may attach to the subject in the mind of a disinterested person, who views it all calmly from a distance, yet by those who have not only their reputations, but their financial prospects, at stake in the success of these jetties, it is deeply regretted that the completion of the work and the securing of the maximum channel have been delayed so seriously, and the success of the enterprise endangered by what appears now to have been false economy, which decided upon the improvement of the South Pass rather than of the Southwest Pass.

To improve, by the force of river currents, a shoal which lies as a great middle ground between the two main outlets of the river, is one of the most difficult of undertakings. To induce the river to leave the channels in which it has flowed for ages, and to seek a new and untried one, is in opposition to its conservative nature; it hesitates long, and is very loth to leave the old ways for the new.

It is necessary to show this almost sentient monster that there are sound hydraulic reasons for changing its ancient habits.

All the works that are built in the funnel-shaped mouth of South Pass, have a tendency to throw a part of its volume into the two large passes, which stand right there with their great, hungry mouths to take every drop that comes within their reach.

To avoid this result of our works, it has become necessary to hold the sections of these passes *in statu quo*, by laying on their beds a sill of willow mattresses, from our works, at the head of South Pass, to the east and west banks of the river.

The total length of these sills is about one mile and a quarter. They are simply the foundations of more extensive works of the same kind, by which we expect to control, slowly but surely, the whole river volume, and draw from it, what South Pass needs to obtain and maintain, a channel, 30 feet deep and 350 feet wide, to the deep waters of the Gulf of Mexico.

Another subject which we wish to refer to, especially, is the "re-formation" of the bar in front of the jetties; that "re-formation" that has been held up by some of our friends, as the great, final and grand obstacle to our success.

In the earlier stages of the work, it was the impossibility of securing even a twenty foot channel that troubled them; the absurdity

of our expecting any such result was so clearly patent to their minds that they thought their argument unanswerable, and convinced themselves at any rate of our prospective failure; but the 20 foot channel came, then the 21, now nearly the 22, and through the jetties a broad, deep channel, from 24 feet to 95 feet deep, has made its appearance, and has thus steadily and surely furnished us facts for our arguments that 30 feet would surely come. .

Of late we hear but little of the absurdity of our intention to obtain a deep channel; but now it is *that bar*, that *new bar*, that is to form so rapidly, close up the jetty outlet, and bring disaster upon the whole enterprise!

Well, it is now two years and a half since we laid the first willow mattress on the South Pass bar. The same enormous volume of mud and water has flowed out through the jetties that formerly spread out like an open fan a mile and a half in width, and in addition to it nearly four million cubic yards of sand and clay have been excavated from the shoal at the head of the Pass and from the channel between the jetties and thrown out into the gulf.

The arguments on either side have facts now, or the absence of them, to prove or disprove the conflicting theories. The time has come when the American people who are to pay for this great work can demand the facts, that they may know whether all the money expended and to be expended, is irretrievably lost in a mud bank that will pay no dividend to its depositors, or will result in a deep and permanent outlet for the Mississippi Valley.

In the limited space allowed us in your crowded columns, we cannot give all the details connected with the facts in our possession. If we could do so, and could illustrate them by maps or diagrams, we could show to the satisfaction of the most obstinent opponent of the jetties that the re-formation of the bar, as prophesied, is a myth. We will briefly allude to the facts and give general results only.

In May, 1875, the United States Coast Survey, under the direction of Mr. H. L. Marindin, one of the most efficient and careful assistants in the department, made an accurate and detailed survey of the South Pass bar. This survey extended into the Gulf about half a mile from the outer crest of the bar.

In October of this year (1877), we made a survey, covering the same ground. The lines of soundings were run in the same manner

as those of Marindin. The general and detailed plan was similar to his. The work was plotted on the same scale. His soundings were increased by one foot and eight-tenths, to bring his plane of reference up to ours.

The whole area in front of the jetties was then divided into squares of one hundred feet. We took it for granted that between any two soundings of his, and also of ours, the slope was uniform. Depths were thus obtained for each corner of each square.

A skeleton was made, on which these squares were drawn; the calculated depth at each intersection was put down in one color for Marindin's survey, and in another color for ours, and we then had the data carefully arranged for calculations by the prismoidal formula. This plan was adopted on account of the unequal spacing of the soundings, and, while it is open to the charge of interpolation, it gives, under the circumstances, the most accurate results.

The depths having thus been put down, the skeleton was subdivided into larger areas and figures. Using the one thousand feet, between the present end of the jetties, as the base of a rectangle, the jetty lines were produced into the Gulf 2500 feet.

This figure was divided again into smaller rectangles of 1000 feet by 500 feet.

The large rectangle was enlarged by adding 1000 feet to the width at the outer end (500 feet on each side), but retaining nearly the same width at the end of the jetties. Then a larger figure still was drawn in the same way, and so on, until the final figure embraced the fan-shaped area of the discharge of sedimentary matter issuing from the jetties during high river.

The calculations show that over the rectangle (1000 feet by 500 feet), lying immediately in front of the jetties and adjacent to their ends, there has been an average deepening of four feet and two inches.

This is the identical ground over which the bar re-formation was to take place so rapidly. The rectangle first spoken of, namely, 1000 feet by 2500 feet, we will call A; the next larger figure B, the next C, and so on, each one embracing all the preceding. The result of these calculations is given in the following table.

A map exhibiting graphically the changes that have taken place, shows clearly that there are well defined areas of scour entirely across the whole mile and a half investigated, and at right angles to the end of the jetties.

We do not need to go beyond this map to prove the existence of a well marked and almost constant littoral or shore current of salt water, sweeping under the fresh water, and not only carrying to one side the vast amount of sediment thrown out of the jetties, but even digging down and cutting into and carrying off much of the original outer slope of the bar.

Letter of Combination.	Area of Combination, in square feet.	Mean gain in depth of Combination, since May, 1875, in feet.	Quantity of material scoured in Combination, since May, 1875, in cubic yds.
A,	2,500,000	0.878	81,341
B,	4,000,000	0.727	107,690
C,	5,300,000	0.996	195,609
D,	6,520,000	1.144	276,328
E,	7,770,000	1.166	335,572

The surveys and calculations made recently by Capt. M. R. Brown, U. S. Engineers, who is detailed by the Secretary of War to inspect the jetties for the Government, corroborated the statements we have made.

In his report of July, 1877, to the Secretary of War, he compares his survey of June, 1876, with that of June, 1877.

We quote some passages that refer to this special subject, and which are found on pages 26, 27 and 28:

"On sheet No. 4 will be found the results of a survey, in June 20th, to June 22d 1877, of a mile or more beyond the ends of the jetties, and for a considerable space on either side."

"The subject of fill and scour beyond the ends of the jetties has occupied so much attention that I have carefully compared the results of the survey of June, 1876, with that of June, 1877, and for the purpose have divided the whole area, comparable by means of the two charts, into twenty-one divisions."

"The fan-shaped areas are, of course, those of the most pressing interest when investigating the influences of changes in the immediate future of commerce."

"Taking into account all the divisions except 1, 7, 13 and 21, we find that the scour in the year was 1,145,976 cubic yards, equivalent to a scour of $1\frac{3109}{10000}$ feet, or 1 foot 3.7 inches over this latter area."