THE OPERATIONS OF THE PRESENT SEASON.

The sum of $12,000 net of the $20,000 appropriated by the river and harbor act of March 3, 1879, has been made available for the work of removing snags.

A call by advertisement has been made for bids, to be opened July 5, and it is supposed that the work projected will be performed under contract during the months of August and September.

For the year ending June 30, 1881, the work which has been sketched in the preceding pages ought to be provided for; and an appropriation of $60,000 is asked for the Sacramento and $3,000 for the Feather.

This sum will be sufficient to make all the constructions that are now considered advisable to build a snagboat and to remove the snags.

The rivers are in the customs-district of San Francisco, at which port there was collected for duties in the fiscal year the sum of $6,147,840.24.

The nearest forts and light-houses are those in the waters of San Francisco Bay.

Reference is made to the appendix for such statistics of trade on the river as it has been possible to obtain.

Money statement.

July 1, 1878, amount available	$15,183 85	
Amount appropriated by act approved March 3, 1879	12,000 00	
		$27,183 85
July 1, 1879, amount expended during fiscal year		16,007 19
July 1, 1879, amount available		11,176 66
Amount that can be profitably expended in fiscal year ending June 30, 1881.		63,000 00

COMMERCIAL STATISTICS.

SAN FRANCISCO, CAL., *July* 7, 1879.

COLONEL: I have the honor to submit the following statement of the general traffic on the Sacramento River during the year 1878, as furnished by the respective companies:

	Tons.
Marysville boats	28,800
California Transportation Company*	55,000
California Steam Navigation Company	80,250
San Francisco Transportation Company	8,875
San Joaquin Wood Company (estimated)	28,000
Total	200,925

Respectfully submitted,

L. J. LE CONTE,
Assistant Engineer.

Col. G. H. MENDELL,
Corps of Engineers, U. S. A.

Abstract of bids received and opened August 1, 1878, *for the removal of snags.*

No.	Name of bidder.	Price per snag.
1	Albert Foster	$55 00
2	Sheldon & Graves	71 00

*Business on this line was very small for 1878, on account of the general overflow of the farming districts.

Abstract of contracts made between June 30, 1878, *and June* 30, 1879.

Name of contractor.	Object of contract.	Price per snag.
Albert Foster	Removal of snags	$55 00

REPORT OF MR. L. J. LE CONTE, ASSISTANT ENGINEER.

SAN FRANCISCO, CAL., *April* 12, 1879.

COLONEL: In compliance with your written instructions dated March 6, 1879, "to proceed by the first opportunity to Courtland or Kercheval's, on the Sacramento River, and sound a selected space above or below Kercheval's repeatedly during the fall of the year, &c., and study to some extent the level and movement of the bottom of the river under changing slopes, velocities, and heights of floods," &c., I have now the honor to submit the following report:

On March 7, by your permission, I engaged the services of two boatmen, and at 4 o'clock p. m., proceeded up the Sacramento River to Courtland. On the morning of the 8th I left Courtland and arrived at Kercheval's about noon of the same day.

Sounding operations were commenced on Monday, March 10, and consumed the greater portion of the day; the remainder was spent in obtaining samples of the sedimentary waters in the channelway of Old River, opposite Kercheval's, the samples being taken simultaneously at five equidistant points along the depth from the surface to the bottom. The apparatus used in taking these samples was an impromptu invention which, however, I found to answer the purposes admirably.

The plan of operations, roughly, was about as follows:

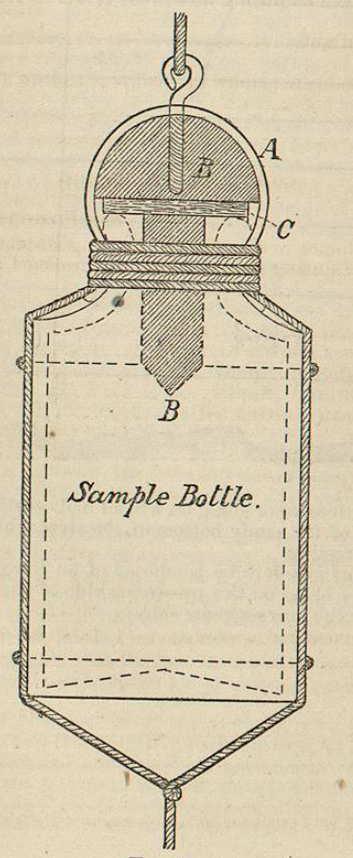


FIG. 1.

Figure 1 in the adjoining sketch represents the details of one of the sediment bottles, together with the necessary valves and other attachments for obtaining and preserving the samples when taken. A = a stout rubber band holding the valve B B tightly down upon its seat, the joint being made snug and water-tight by means of the soft leather washer *c*. The bottle can be opened and closed at will by bringing the proper strain upon the connecting line, and can be closed by relaxing the strain.

Fig. 2 represents the boat floating down stream freely with the current, and the coxswain in the stern in the act of taking samples. In order to take the set of samples, firstly the leadsman allows his line to run out slowly while the coxswain pays out the sample line with bottles attached, so as to hang in a bight; this continues until the lead strikes bottom. The coxswain then takes his sample at will, by simply hauling taught on the sample line, which strain opens the valve covering the mouths of each bottle, thus causing the same to be filled with the water samples desired. Relaxing the strain on the sample line causes the valves to close tightly, by reaction of the rubber bands, thus safely securing the samples in each bottle. The samples are thus rapidly hauled to the surface and into the boat by means of the lead line, the sample line being allowed to haul loosely in a bight.

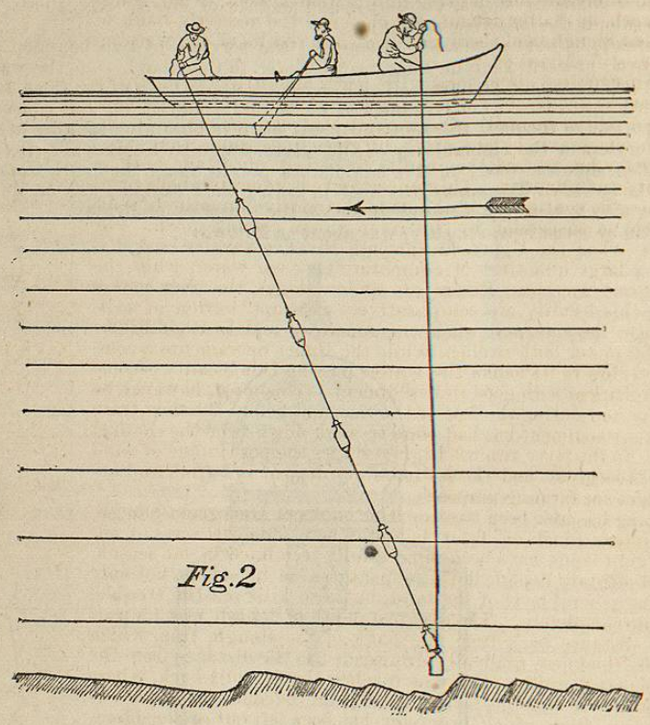
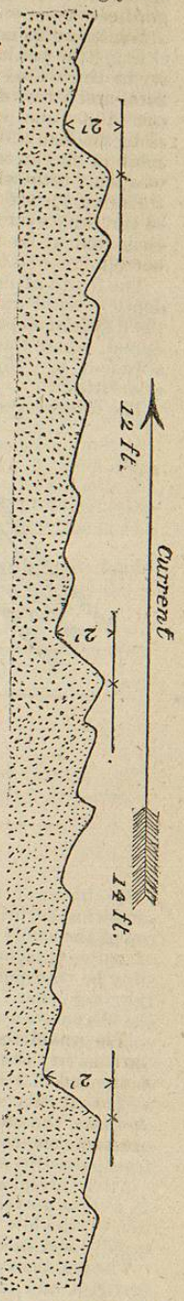


Fig. 2

The sounding operations were going on when I had occasion to notice certain irregularities in the surface of the sandy bottom of the river which upon careful examination proved to be interesting.

The surface sand was found to be composed of an irregular system of ridges and hollows, the flat slopes being on the up-stream side of the ridges, while the steep or unstable slopes lay on the down-stream side.

The following sketch represents the relative form and dimensions of these fluvial "sand dunes," so to speak:



These same features were observed on a grand scale throughout the entire channelway of Feather River between Marysville and the mouth, where the exceedingly shallow and scattered water afforded rare opportunities for examination

The observations for velocity of current were taken by means of single and double can floats of large dimensions, the results of which showed the surface velocity to be = 5.50 feet per second, at the depth of 18 feet below the surface velocity = 4.48 feet per second, the depth of water along the path passed over by the floats being from 20 to 25 feet.

The stage of the river, while the above observations were being made, was =11 feet above low-water adopted.

On March 11, I took the opportunity of examining into the experience of old settlers who had tried the warping system of reclaiming lands before the construction of the existing system of levees. In order to obtain this desired information I went to Mr. Sullivan's ranch. on Sutter Island, which forms the westerly bank of Steamboat Slough, and there saw the fresh results of the warping system as still carried on.

I had instructive discussions with many old settlers in regard to these matters, the result of which is about as follows: I ascertained, in regard to the quantity of sediment that can generally be obtained in one season by any ditch of given dimensions, that experience so far has proved the results to be very uncertain, both as to quality and quantity. This uncertainty is brought about principally by the continual variations in the relative quantity of sediment held in suspension by the river waters coming down. For example, when the Upper Sacramento River is swollen and discharging large quantities of comparatively clear water, while the Feather and American Rivers are at low stages, the river waters passing this locality are comparatively clear and barren of sediment. On the contrary, when the American and Feather Rivers are either one or both swollen, while the Upper Sacramento is comparatively low in its banks, the waters passing this locality become densely charged with good rich sediment. This must, however, be caught on and during the first of the rise, and before the slow-traveling sandy sediment has had time to work down from the channel above. As the river reaches higher stages the percentage of sand becomes too great, and the sedimentary deposit is barren and objectionable for farming purposes.

Warping has also been tried on the banks of Georgiana Slough, near Winter's ranch on Tyler Island, where some 200 acres of adjoining tule lands have been successfully reclaimed in one season. The sedimentary deposit in these instances, as in others, not only raises the general level of the land, but also kills out the troublesome tule completely. The greatest depth of deposit was 3.5 feet, a short distance back from the bank of the slough, from which point the thickness gradually diminished as the distance from the bank increased, until a point was reached about ½ mile back, where the deposit was barely 3 inches in depth. Beyond this there was more or less filling, which, however, has been left out of consideration, being spread out in a manner such as to render a fair estimate very uncertain.

From the data, such as were furnished by the neighboring ranches on the river, I think I am justified in expressing the opinion that by opening a single ditch 3 feet wide and 8 feet deep (at the bank), extending, say, 200 feet back from the margin of the river, a farmer can in a single season fill in 30 to 35 acres of low land to an average depth of 2.5 feet, which corresponds to a deposit of 108,900 cubic feet per acre. This presupposes that the rise in the river is on an average such as to cause the ditch to flow for an average period of 3.5 months.

All farmers throughout this section of the country, who have given the warping system any trial, agree in their convictions that, when conducted with judgment and careful consideration of the sedimentary character of the waters to be used, there is not the least reasonable doubt but that a large per cent. of the sediment transported by the first rise in the Sacramento River could be usefully disposed of by the riparian proprietors.

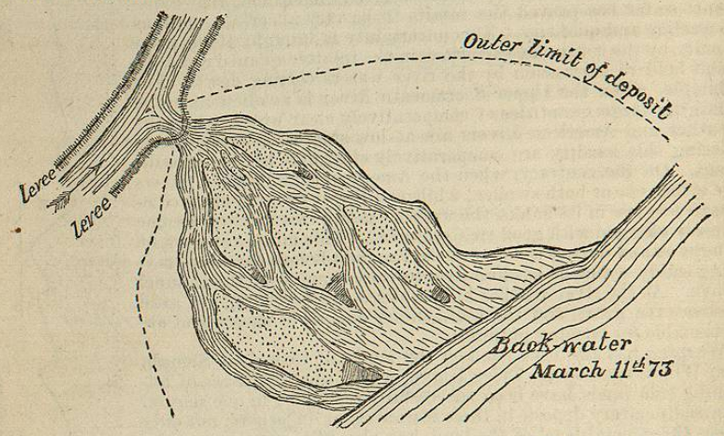
As heretofore practiced the percentage of barren sand was entirely too great, whereby the warped lands were useless for agricultural purposes for an average of five years after the deposit was made; moreover, the practice heretofore has been to allow the ditches to remain open throughout the entire high-water season, say, 3.5 months, regardless of the physical conditions of the river water during that period.

While in this neighborhood I also had occasion to examine a large break in the levee skirting the banks of Steamboat Slough, which had caused a large area in the vicinity to be covered with sedimentary deposit of considerable depth, some being beneficial and others detrimental in their character to farming interests. This break occurred in February, 1878, and was the site of an old warping ditch. It extended along the bank for a distance of about 150 feet, and the quantity as well as the character of the materials deposited throughout this vicinity, in delta-like formation, was truly astonishing.

The number of acres appreciably raised by the barren sand alone was estimated to be certainly over 60, while the area covered by fine muddy sediment may be safely estimated at 30 to 40 acres more, making in all some 100 acres of reclaimed tule bottom.

The depth of deposit was greatest about 200 yards back from the bank, where the depth of sand was fully 8 feet; thence out westerly, as you advanced into the tule, the depth of deposit gradually diminished until it reached about the middle of Sutter Island, where the deposit was only a couple of inches in depth and mostly pure clayey sediment or "slickens," such as is seen in the channel of Feather River in large quantities.

The following sketch represents the main features of this break:



Specimens of the different varieties of sediment are herewith transmitted. I was somewhat surprised to find a very large quantity of coarse rounded gravel lying on top of the sandy deposit, varying in size from that of ordinary domestic beans to that of ounce musket-balls. I cannot conceive how gravel of such dimensions could possibly be transported by the comparatively slow currents along this lower section of the river other than by simply rolling along the inclined plane formed by the bed of the channel-way; moreover, I am of the opinion that the fact of the existence of such coarse gravel discharged from a crevasse in this portion of the river goes to prove conclusively that there must have been an extensive deposit and corresponding rise in the bed of the adjacent channel-way simultaneous with the crevasse; and furthermore that this channel deposit extended up to and on a level with the bottom of the crevasse, thus forming a more or less continuous inclined plane following the river bed and out through the crevasse, along which the heavy gravel in question was transported by simply rolling motion.

After careful study of all the data on this subject, furnished by warping operations as well as crevasses in the levees, I am now decidedly of the opinion that a large portion of the low tule lands adjoining the Sacramento River and its tributaries can be rapidly and successfully reclaimed by a properly regulated system of warping sluices.

These sluices should be deep-seated at the bank, so as to catch the sediment of the first rise, and should be made in the form of wooden boxes, or, better still, wrought-iron pipe supplied with suitable cut-off valves, by which any waters containing objectionable sedimentary matter may be cut off at will. The water after passing through the sluices can be then led to different portions of the area to be filled according as the deposition of the material may dictate.

All the lower islands in the Sacramento delta, such as Sherman, Bannan, Twitchell, &c., the reclamation of which has been attended with disastrous failures, can by this system of operation have their general level so raised as to render subsequent reclamation a comparatively easy matter.

On March 12 I made a second series of soundings along Old River and Steamboat Slough, and took observations for velocity above and below their junction, as well as in said slough. Above the junction I found the surface velocity to be = 6.54 feet per second, while at the depth of 16 feet the velocity by means of double cans was found to be = 6 feet per second, the depth of water along the path of the floats varying from 18 to 28 feet.

Below the junction and opposite Mr. Kercheval's the surface velocity = 6 feet per second, while the subvelocity at a depth of 16 feet was found to be 5.90 feet per second, the depth of water along the path of the floats varying from 18 to 25 feet.

Observations for velocity were also taken in Steamboat Slough, but subsequent criticism led me to question the results, the conditions of flow being unsatisfactory in many respects.

While the above observations were being taken the water at the gauge stood at 11.40 feet above low-water adopted.

The cross-sections made at the head of Steamboat Slough do not exactly coincide with those taken in November, 1878; consequently I am unable to show as reliable comparative results as were obtained along the Old River channel.

On March 13 I thought it would be advisable to examine an additional reach of the river above Kercheval's, and thus obtain corroborative evidence with regard to the rise of the river bed, and then take channel soundings on my return down-stream.

Accordingly I proceeded to Courtland, and there sounded over a portion of the channel-way surveyed last November. The results showed a very perceptible increase in the relative rise of the sandy bottom as compared with that shown by soundings made at and near Mr. Kercheval's house. On my return I took channel soundings; these results are plotted on Sheet No. (—), showing comparative longitudinal sections of the channel for a distance of 2.25 miles, wherein it will be seen that the rise in the level of the bottom was about 3 feet, and quite uniform.

Observations for velocity were taken abreast of Courtland wharf, which was found to be = 6 feet per second in mid-channel, the water on the gauge standing at 11.20 above low-water adopted.

On March 14 the party took passage on the steamer Reform, and started down river for San Francisco. While on the way I caused channel soundings to be taken from the lower deck of the steamer at and near the Ironhouse Shoal in Old River.

The results of these soundings can be compared with those taken in December, 1878, when the latter shall have been plotted.

* * * * * * *

Respectfully submitted.

L. J. LE CONTE,
Assistant Engineer.

Col. G. H. MENDELL,
Corps of Engineers, U. S. A.