$5\frac{1}{2}$	inches high.	0 lbs.
$4\frac{1}{2}$	" "	10 "
$3\frac{1}{2}$	" "	20 "
$2\frac{1}{2}$	" "	30 "
$1\frac{1}{2}$	" "	40 "

Rule for the strength of Locomotive springs:

$$L = \frac{B\,T^2\,N}{11 \cdot 3\,S} \qquad N = \frac{11.3\,S\,L}{B\,T^2}$$

In which S = span of spring, in inches.
B = breadth of plates, in inches.
T = thickness of plates, in sixteenths of an inch.
N = number of plates.
L = safe load on spring, in tons.

Molesworth Pocket Book, 1865.

Springs.—The flexure of a spring is proportional to its load and to the cube of its length.

Deflection of a carriage spring.—A railway carriage spring, consisting of 10 plates $\frac{5}{16}$ in. thick, and 2 of $\frac{3}{8}$ in. thick; length 2 feet 8 in.; width, 3 in., and *camber* or spring 6 in., deflected as follows, without any permanent set: $\frac{1}{2}$ in. under a half ton; 1 in. under one ton; $1\frac{1}{2}$ under one and a half tons; 2 in. under two tons; 3 in. under three tons, and 4 in. under four tons.—*Haswell*, 1867.

(To be continued.)

THE OVERFLOW OF THE MISSISSIPPI RIVER.

By D. S. Howard, C. E.

The recent New Orleans flood is another reminder of the neglected laws that govern the action of water over beds and between banks of yielding material. Like all other calamities, it is calculated to draw our attention to precautionary measures against the recurrence of other similar disasters.

It would seem to be too plain to require repetition, that the temporary effect of the Levee system, for promoting the overflow of the Mississippi banks, is worse than useless. The rise of the bed of the river is as sure to follow every freshet, which is confined within its banks, as it is that the freshets bring down sediment that is not disposed of by crevasses, rendering the section of the stream less than the capacity required by the next freshet, consequently requiring increased height and strength of levee every year.

It may not be clear to every person, how the sediment should be deposited more by freshets than by a less flow of water, on the same bed. But there is more sediment in a freshet than in low water, which is deposited more readily in proportion to the difference between the inclination of the surface of the water in a freshet, and in low water, with regard to the inclination of the river bed, which is the same in both cases. The rise in the water being greater above than at the mouth, to give the necessary velocity to dispose of the surplus water of a freshet, confined within limited banks, increases the inclination of the surface, while the bed remains the same; it also increases the section of the stream more above than below. This, together with the action of gravity on the water with increased motion and inclination of surface, and consequent greater reaction on the bed, has the effect to diminish the motion of water nearer the bed of the stream, and throw down more sediment than will be deposited when the bed of the stream is nearer parallel with the surface.

Whatever difference of opinion may exist about the theory, the fact has been established by experiment that the motion of water near the bed of streams is less in freshets than in low water. Common observation also teaches us that the beds of the lower waters of all similar streams to the Mississippi, where the freshets are confined within the limits of their low water banks, are annually rising. With these facts in full view, it seems easy to comprehend the necessity of adopting some other means of avoiding all similar catastrophes by looking towards the source of the evil instead of confining our gaze on the evil itself. By such a deviation from the too common course, we shall soon see that freshets may be arrested near where they originate, much easier than they can be confined, after a combination of a large number of tributaries have collected their forces and concentrated them on a main outlet like the lower Mississippi.

By the selection of proper sites for reservoirs at or near the head waters of rivers, it is very easy to see that much less expense of dams will prevent a freshet than will prevent an overflow of the lower river banks by levees.

The argument against reservoirs is the danger of breaking away, of which there is no necessity whatever, if properly planned and constructed. If the reservoirs be numerous, as they must needs be on the Mississippi, it would not be at all probable, in any event, that all would break at the same time, or enough to do any harm; whereas, the dykes, being necessarily more extensive, are proportionably more

liable to break in some part of the two long lines, always doing more or less damage, according to the extent of the freshet and the location of the breach, without the possibility, sometimes, of repairing the crevasse until the freshet subsides; while a reservoir dam may be immediately repaired, ready to check the torrent in case of any other similar accident.

Many of the reservoirs may be located as to be worth more than their cost for the water power they would provide, but the greatest advantage to be derived from them on the Mississippi River would be the benefit to navigation, by affording more water in a low time, and preventing the accumulation at the mouth, which is now the effect of every freshet.

It is now well known that the bar at the mouth of the Mississippi is the worst at the time of the highest freshets, affording the least depth of water for the entrance of ships. But the low season allows the salt water to flood the bar, and float up the new deposit made on the clean washed low water bed, in the shape of what is called "mud lumps," from the greater weight of the salt water to that of the newly deposited sediment, assisted, perhaps, by fermentation of vegetable matter contained in the sediment, during the hot season, subsequent to the freshet; after which there is a greater depth of water over the bar, until another freshet has forced the heavy salt water from the location, when another bar is formed as before.

This consideration alone should be sufficient to induce any Government, with competent foresight, to institute an inquiry, at least, calculated to solve the mystery of the right plan for overcoming the great evil attending the uncontrolled freshets of the Mississippi River, which would also provide a specific for the freshets on all similar streams as well.

No investment of public lands or public money could be made that would afford the same returns as the permanent improvement of the Mississippi and its tributaries by the Reservoir system. This plan has the uncommon merit of being progressive.

When a reservoir is properly constructed, it is a permanent improvement as far as it goes, whether the system be extended or a return to any other system be adopted, it works equally well; therefore, if the estimates of the engineer in charge be not satisfactory, an experiment may be made without a total loss, as with most experiments. The amount of water withheld from a freshet by a reservoir reduces the freshet and its effects, and the additional levees required,

in exact proportion to the capacity of the reservoir, for all time to come, whether any more be constructed or not; and if the Reservoir system be carried out to its fullest extent on any river like the Mississippi, so as to equalize the flow of water at all times, the stream will soon acquire a fixed regimen; every yielding obstruction to the full capacity of the stream will soon have given way to the continued action of the water, affording an uninterrupted navigation, with a permanent location of the stream, which can be obtained by no other means.

The following are some considerations in favor of the Reservoir system in contrast with the Levee system:

Reservoirs require no additions or repairs from year to year, if properly constructed.

Levees require additions every year, in proportion to the amount of deposit on the bed of the river left by the preceding freshet.

Reservoirs retain the sediment of the freshet in proportion to the amount of water retained, and lessen the accumulation in proportion to the diminished height and velocity of the surface current.

Levees increase the amount of sediment in proportion to the increase of height and velocity of the surface current by the freshet.

Reservoirs create a fixed regimen and location for a stream, when the system is fully carried out, which frees the banks above the surface of the water from abrasion by currents, while the lower banks and bed of the stream are soon washed clean of their yielding particles, producing a uniform pure, clear water stream in all seasons of the year, affording the least amount of material for the bar at the mouth.

Levees, when the most successful, cause the highest freshets and the greatest amount of abrasion of the banks, consequently the most variation in the course of the stream, affording the largest amount of material for the bar at the mouth.

Reservoirs, by promoting the overflow of large surfaces of land in warm climates, lessen the amount of fresh material for miasm, so abundantly supplied by freshets, and so prejudicial to health.

Levees, if permanent, must necessarily expose a large amount of saturated surface, covered with sediment, between the levees, after every freshet, to the action of the sun; but, if not permanent, the disaster to health as well as property is very great.

Richmond, Virginia, 1st July, 1871.