

A second objection is, the use of timber for the longitudinal trussing and flooring. It is objectionable from presenting more surface to the action of the wind, but more particularly from much greater weight of material being required to gain a given longitudinal stiffness. Fir timber of a given weight will extend or compress 2.5 times the amount of a similar weight of good wrought iron, although the specific gravity is as 1 to 10; and the parts of an iron truss or girder admit of being secured together so as to retain a larger proportion of the action of the fibres than is the case with wood.

A suspension bridge should have the platform or roadway also of iron, so as to act as a horizontal girder and resist the action of the wind. By the use of iron in the platform and girders, a weight of 400 tons in the place of 600 tons of timber would have reduced the deflection of the wave to one-third, and would have rendered unnecessary any anchorage to prevent the action of the wind.*

A third and final objection applies to nearly all suspension bridges, hitherto constructed, viz., the cables are supported on carriages on rollers, instead of being attached to the towers.

An engineer, when he constructs an arch, would not expect to have a rigid structure if he placed the abutment on rollers, and how can he expect in a suspension bridge to have rigidity if he adopts a similar expedient?

We are apt to follow what has been previously adopted without reflection, and desire to avoid the responsibility of a change of an adopted system; but there is no difficulty in attaching the cables to the towers if they are of iron, and constructed so as to act as vertical girders, to resist the inequality of the weight which may arise on the different spans of a bridge. In fact, you cannot expect perfect rigidity in a suspension bridge as they are now constructed; but there is no reason why they should not be treated like an arch reversed; and if they were so treated there is nothing in the suspension principle to render them less rigid.

There is, however, no intention to imply, by these observations, that the Niagara Bridge is less durable from these omissions to any appreciable extent. I believe, provided the timber and masonry are kept in repair, it will last for hundreds of years, and that a certain degree of motion in a bridge does not affect its strength or durability, provided no strain in any part exceeding the elasticity is produced; at the same time, by the means pointed out, the undulation and vibration, small as it is, would be considerably reduced.†

(To be Continued.)

*The towers should also be of iron, in order that the expansion may correspond with that of the suspension rods. The suspension rods should be at right angles to the cables, and fewer in number, by which the tremor as well as the undulation will be reduced.

†See the report of Mr. Roebling, C.E., in the *Engineer*, September 21, 1860, and *Jour. Frank. Inst.*, vol. x1., Dec., 1860, p. 361.

Query respecting Suspension Bridges.

To the Editor of the Journal of the Franklin Institute.

SIR:—I may be mistaken (and if so, shall be glad to have my error corrected) in believing that the design for a suspension bridge of four

spans of one thousand feet each, and two spans of five hundred feet each, which I prepared early in the year 1851 immediately after my return from the Panama Railroad, and which was exhibited for several months of that year in the reading-room of your Institute, was the first proposition for applying that principle to railroad purposes on a large scale. The design (which is fresh in the memories of many visitors at your rooms) was prepared with the object of showing the practicability of uniting the Philadelphia and Columbia Railroad of Pennsylvania with the Camden and Amboy Railroad of New Jersey by crossing the River Delaware at Market Street, Philadelphia, without either obstructing the navigation of the river, or incurring an excessive expense. The entrance to the bridge on the Philadelphia side was at Second Street; and the floor was placed 100 feet above high water, so that the few large vessels which ascend above Market Street could pass with ease by striking their top-gallant masts; a very simple operation requiring but a few minutes to perform. The rigidity of the bridge was provided for on the same general principle as in the Niagara Suspension Bridge built since that time; namely, by strong timber trussing about twenty feet deep, put together on the system well known as the, so-called, Burr's plan, but omitting the wooden arches. The entire design was very much the same as I should now adopt if called on to plan such a bridge. My drawing was also placed in your annual exhibition of 1851; and was afterwards removed to the public room of the Merchants Exchange, where it remained for several months; and from which it was taken during my absence in South America engaged in the exploration of Humboldt's proposed interoceanic canal routes in 1852. It elicited one or two notices in the newspapers of the day; but was very generally regarded as a chimerical proposition. I have never been able to ascertain by whom it was removed. If this notice should meet the eye of any person acquainted with its present whereabouts, he will confer a favor by informing me of it.

JOHN C. TRAUTWINE.

Philadelphia, Dec. 7, 1860.

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

Alloys of Cadmium. By B. WOOD, M. D.

In a former communication,* I took occasion to speak in general terms of some of the properties of cadmium as exhibited in combination with other metals, in order to draw attention to certain characteristics which appeared to have been overlooked heretofore. I now propose to speak of some of its specific combinations by way of illustrating its properties in particular connexions. I confine myself to the results of my own experiments.

These experiments were made at different periods, as occasion

* Journal of the Franklin Institute for August, 1860, page 113.