was found to require it. These circumstances have produced a change in opinion hostile to the whole plan, and it is much to be regretted, that instead of introducing such modifications and improvements as would remedy existing defects and retain its advantages, other plans have been substituted at an expense frequently more than double that of an efficient lattice structure.

One of the first defects apparent in some old lattice bridges, is the warped condition of the side trusses. The cause which produces this effect cannot perhaps be more simply explained than by comparing them to a thin and deep board placed edgeways on two supports, and loaded with a heavy weight; so long as a proper lateral support is furnished, the strength may be found sufficient, but when the lateral support is removed, the board twists and falls.

A lattice truss is composed of thin planks, and its construction is in every respect such as to render this illustration appropriate. Torsion is the direct effect of the action of any weight, however small, upon the single lattice.

A second defect may be found in the inclined position of the tie; all bridge-trusses, whatever may be their particular construction, are composed of three series of timbers; those which resist and transmit the vertical forces are called ties and braces, and those which resist the horizontal force are known by the names of chords, caps, &c.

In every plan except the common lattice, these ties are either vertical, or perpendicular to the lower chords or arches, and as the force transmitted by any brace is naturally resolved into two components, one in the direction of, and the other at right angles, to the chord or arch, it would seem that this latter force could be best resisted by a tie whose direction was also perpendicular. The short ties and braces at the extremities, furnishing but an insecure support, render these points, which require the greatest strength, weaker than all others; this defect is generally removed by extending the truss over the edge of the abutment a distance about equal to its height, or to such a distance that the short ties will not be required to sustain any portion of the weight, the effect of which is to provide a