Substituting $\frac{5}{4}d$ for d_1, and $0.274(\frac{5}{4}d)$ for w, gives

$$0.274(\tfrac{5}{4}d)^2T = \frac{\pi d^2 S}{4},$$

and

$$S = 0.545T;$$

for $T = 5$ tons, $S = 2.725$ tons. But the greatest allowable value for S is, according to Bender, 2.91 tons. This proves, that, if an iron pin be properly proportioned for crushing and bending, it will be strong enough to resist shear, and in fact, that, before the pin could shear, it would either break by bending or crushing, or the eye of the bar would give way. A similar investigation for steel bridges, where $T = 8.35$ tons, $C = \frac{7}{4}T$, and R (the intensity of working bending-stress) $= 1.8T$, gives $d = 0.5714d_1$, $w = 0.1816d_1$, and $S = 5.912$ tons $=$ the actual intensity of shearing-stress when the pin is strained up to the bending-limit, and the ratio $\frac{w}{d_1}$ for that condition of stress is at its minimum, and consequently the area of the bar, the tension therein, and the shear on the pin, at their maxima. But the greatest allowable shear is, according to Bender, $\frac{4}{5} \times \frac{8}{11} \times T = \frac{32}{55} \times 8.35 = 4.858$ tons; so that, for a pair of steel bars pulling on a steel pin in opposite directions, or a single steel bar against a steel bearing, the pin in certain cases will be liable to rupture by shearing, and will therefore have to be proportioned to resist that stress.

After making out the diagram of stresses, and proportioning the main members of a bridge, comes the determination of the sizes of the pins, — a matter that is liable to occupy more time than did all the previous work. Knowing the sizes of all the bars in the structure, the clear width between the inner faces of the top chord channels (and consequently that between post channels) can be found, after which the arrangement of all the bars in the bridge can be decided on. Care must be taken in performing the latter, that no two consecutive chord bars or ties coupled on the same pin pull in the same direction, unless this arrangement reduce the bending-moments, as it can sometimes be made to do; that the lighter set of bars be so placed