engineer,) estimates the effects of the engine and tender as "equivalent to 32 tons in the centre," which is equal to 64 tons distributed. Add to these, "25 tons of ballast," which was put on to the bridge just before the accident, and we see there was $90 + 64 + 25 = 179$ tons upon the bridge, which was more than six-tenths of the actual breaking weight, supposing it all at rest, and acting equally on the two girders. But the action of the engine, and the vibration of the girders, (which must be considerable for a length between supports equal to 26 times the depth,) must be very important, though not capable of exact estimation. It is therefore not improbable that the girder was taxed to more than two-thirds of its extreme capacity under favorable circumstances.

Now, from one-quarter to one-third of the actual breaking strain, is all that any practical engineer estimates it safe to rely on cast iron to bear; whereas, in case of the Dee bridge, we see it exposed to a load of more than six-tenths of the ordinary capacity, besides the effects of motion, vibration, &c. It certainly cannot be surprising, then, that a failure took place. And so far from this failure amounting to evidence, or even an argument, against the safety of iron bridges, the fact that this is the first and only failure that has yet taken place, among "upwards of 100 similar bridges either in use or in the course of construction, in England," some of which are doubtlessly, often exposed to strains exceeding half their absolute capacity to bear, seems calculated to inspire the fullest confidence, that, properly proportioned, so as never to be exposed to a stress of more than one-fifth or one-quarter of the average strength of the metal, iron bridges may be relied on with the utmost confidence.

We see that the Dee bridge contained some 70 tons or more of iron in the girders, for a single track of 98 feet stretch,* besides 20 tons in the other work, which is nearly one-third of the actual breaking weight of the girders; and as much or more than they ever should or could with safety, be exposed to.

The English engineers seem to me to have erred, in deducting the weight of the structure from the breaking weight, instead of the safe load of the girders, to obtain the effective strength.

Now, that the most eminent engineers, of a most scientific nation, should be obliged to avail themselves of the extensive employment of such a plan of structure as that, is evidence enough of a prevalent want of more light upon the subject of Bridges. And whether my labors in the field will have aided essentially towards supplying the deficiency, it is unnecessary for me to give a more direct expression of opinion, than will be afforded by respectfully offering these humble essays to the attention of the engineering profession.

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*I estimate the amount of iron for a like stretch upon my plans, at about 15 tons.*