Professor Kernot continues:—"Thus you see we have examples of almost every possible error in bridge designing, and all in bridges designed by most eminent and experienced men, members of the Institution of Civil Engineers, etc.

"My great trouble is that these bridges don’t tumble down—so long as they stand I have the greatest difficulty in getting people to believe me;—‘you unreasonable man, can’t you see that the bridges stand; what more do you want.’ And the way they stand is most wonderful.

"We have bridges for foot passengers and road traffic in which a dense crowd would load the iron in vital parts to fifteen tons per square inch; and they have stood for many years. To account for their not falling down has been my greatest difficulty. I think, however, that the following considerations explain it.

"1.—They are never loaded with anything approaching their full load. This is especially true of road bridges. A bridge of 150 feet span, twenty feet wide, might be loaded with one hundred tons weight, were a dense crowd to assemble upon it; but, as a matter of fact, the chances are that it will never have more than ten or at most twenty tons on it at once. The big load is perfectly possible, but in the highest degree improbable, especially in localities where there is but little population.

"2.—Though five tons per square inch is no doubt a judicious limit to the stress imposed on the material, it is nevertheless a fact that fairly good metal will stand many hundreds or perhaps thousands of repetitions of a stress of ten tons per square inch before failing.

"Thus you see the bridges may stand for many years, and yet may fall at any moment.

"The facts are very plain to see. With very few exceptions all our leading engineers are men who have never really mastered the first principles of statics. They were educated forty years ago, and their education comprised no real mathematical training. They design their structures partly by copying existing works and partly by guess-work. Owing to a favourable combination of circumstances they have escaped disaster. The margin allowed under ordinary rules to cover imperfections of materials and workmanship has in reality served to cover errors of design; and the heavy loads ostensibly provided for have rarely, if ever, come upon the bridges.

"For a younger man, a so-called theorist, to rise up and accuse them of incompetency is very rough indeed, and they find a ready escape by crying ‘experience,’ ‘the bridges stand, and that proves they are right.’ The non-mathematical public, bewildered, know not which to believe. ‘Professor Kernot is a very clever man, and talks well, but we prefer to trust our old experienced friends’—‘theory is all very well, but practice is another thing,’ and so on. Then I make experiments on models, and people say, ‘Very nice, indeed, but we haven’t much faith in experiments on toy models’; and my last resource, experiments on full size girders, is out of the question on account of expense.

"Still I produce some effect. The railway foot bridges are now of a better form than they were; and even those engineers who indignantly deny the