occasion, as much duty in proportion to weight on driving-wheels as the American engines had done as a regular duty on that railway every day for a year. This offer was never accepted.

In 1870 Mr. Fairlie had some experimental trials of his engines in England in the presence of some foreign Counts and other noble railway experts. They declared the results to be wonderful, and were more than anxious to sign the strongest certificate that could be drawn. The data of these trials was sent to me. Wishing to see how it compared as to duty performed at two Government trials (one in Peru and one in Chili, South America) with engines under my direction (the trials being under the eyes and certified to by clever and experienced English engineers), I reduced the data of all down to one common basis of comparison—namely, foot-pounds of work done per hour per ton of weight on driving wheels, in moving train along, exclusive of engine. The results were as follow: Fairlie engine "Little Wonder," Festiniog Railway, gauge 1 ft. 11½ in., equal to 9,024,739 foot-pounds; Fairlie engine "Progress," Mid-Wales Railway gauge, 4 ft. 8½ in., equal to 9,272,339 foot-pounds; Rogers's American engine "San Bernardo," Southern Railway of Chili gauge, 5 ft. 6 in., equal to 41,587,020 foot-pounds; Rogers's American engine "Conquistador," Arequipa Railway of Peru gauge, 4 ft. 8½ in., equal to 25,377,544 foot-pounds. A full table of these comparisons was published in *Engineering*, 11th November, 1870.

I will send you a copy of these comparisons and also a pamphlet in reference to this much-lauded Fairlie engine. Mr. Fairlie has never been desirous to put his engines on any railway unless he could "saddle" his locomotive superintendent also on the railway. Mr. Meiggs, the railway contractor of Peru, gave Mr. Fairlie an order for one of his engines, after much solicitation, merely to test it. Mr. Fairlie wished Mr. Meiggs to build his Trans-Andean Railways with "breathing-places" for his engines. Our engines have now worked those railways for years without lung-complaints, these railways having gradients for many miles of 1 in 25, and sharp curves for nearly the entire distance up to the summits. One railway has over 70 miles that is over 14,000 feet above the sea-level. Mr. Fairlie, in writing to Mr. Meiggs, says, "There is no engine of the ordinary type built in England of the description you give, as far as I can understand it, capable of doing anything like the duty you report having done—namely, 135 tons, exclusive of engine, over a grade of 1 in 25, at a speed of 11¼ miles an hour. It would puzzle *even* a Fairlie engine to do such a duty. There must be some peculiarity in the climate or the gradient, or in *something or other*, which enables you to get such enormous duty out of your engines compared with what we can get here."*

Mr. Fairlie had *carte blanche* to build one of his engines and send it to Mr. Meiggs, in Peru; but he never did it, there was *something or other* in the way. Mr. Maxwell says that Fairlie engines on the Great Southern Railway of Ireland showed an average of 25,000 miles a year for three years. Now, as I am sure that this is what a Fairlie engine never did, I am led to believe that this is another error of figures in Mr. Maxwell's letter; and particularly as the Fairlie engines on the Mexican Railway, under the direction of one of Mr. Fairlie's own men, showed no such mileage. In 1874 the manager of that railway made out a statement in detail of the performances of the Fairlie and Baldwin engines, running from Vera Cruz to Boca-del-Monte. This table can be seen in full in the report of Augustus Morris (Commissioner to the Centennial) to the Government of New South Wales. This table, reduced, gives the following figures:—

Fairlie engines, miles per annum	14,371
Baldwin „ „ „	28,673
Fairlie engines, running and repair expenses per mile	79·32c.
Baldwin „ „ „ „ „	37·66c.

The above is for the only two Baldwin engines on that railway, and for the six best and newest of the seventeen Fairlie engines they had in December, 1874.

Mr. Maxwell says that the average mileage of the engines of the London and South-Western Railway is 25,000 miles. Now, although this railway does give the largest average of any railway in England, I cannot find a single year in which it gives as high as 25,000; but I do find this very railway figuring in the list of the twenty railways in England giving an average of 18,336 miles; again, in the list of twenty-two in England giving an average of 17,934; and again in the list of twenty engines given by McDonnell as averaging 17,625, all as mentioned in my letter to Mr. Higinbotham. I would ask Mr. Maxwell if he thinks it fair, in a discussion of this kind, to pick out the railway that gives the largest average and parade its figures as a set-off to the averages of twenty railways.

Mr. Maxwell says that Mr. Brereton and Mr. Evans claim a larger mileage for American engines than is shown by English engines, without a single qualification. This is a singular assertion. We give the mileage as printed in English papers, which I took the trouble to confirm by official figures, and then we state that this mileage is made in America on roads subjected to a more severe climate, gradients, curves, tracks, and loads. If that is not qualifying the mileage statements, then I am at a loss to know what kind of qualification Mr. Maxwell desires.

Some twenty years ago the *Engineer* published a statement of an engine performance in the United States, and then commented on it as follows: "The above engine performance, together with other similar data published in former issues of this paper, shows that from 20 to 25 per cent. greater duty is obtained from the locomotive in America than we can get here, and that, too, over what we know to be notoriously inferior tracks to ours. What can be the reason?" The Editor of *Engineering* once wrote to me in the same strain, and asked me to write him on the subject and explain the causes.

Mr. Maxwell says there are many ways of computing train-mileage. This is news to me. It must be a most objectionable record that has entered on it more or less miles than the engine actually run and hauled a train.

Mr. Maxwell says it is questionable if low speed is a drawback in obtaining a larger train-mileage. This is another singular assertion. Surely he cannot mean that a goods engine running 10 miles an hour makes as great a mileage as a passenger engine that runs 40 miles an hour.

Mr. Maxwell alludes to Mr. Brereton's remark that some engine economy may be obtained by running with two crews to an engine, and infers from this that the greater average train-mileage of American engines is obtained in this way. I would state that this matter of double crews on engines is of very recent date, and is now practised only on some trunk-lines for their heavy-goods trains. The mileage made by American engines, and referred to in Mr. Brereton's and my letters, was not, in any case, made by engines having two crews.

The practical inference to be drawn by *professional* thinkers, when told that one system of railway equipment results in engines making an average of 15,000 miles a year with loads of 200 tons, while another system, on similar lines, or more difficult, with equal loads, gives an average of 30,000 miles a year, is that the road with the 30,000-mile engine can whip out the other in the ratio of 2 to 1.

When I got an official report of the workings of the Fairlie engines on the Mexican Railway and laid it before the Baldwin Locomotive Works Company they said, "With such data the proof is clear that we could, with nine of our Consolidation engines on that railway, do all the work done by the seventeen Fairlie engines." Here comes in a point that is easily understood by the *unprofessional* mind. The nine Baldwin engines would cost in Mexico £26,000, while the seventeen Fairlies would cost £36,000, to say nothing of their greater cost for repairs, fuel, and destruction of track.

Mr. Maxwell says that this engine subject is taken up as if it was new and not before discussed. I beg to differ with the gentleman. It is well known to every railway engineer and investigator as an old subject, written on and discussed in various ways during the past forty years by some of the best and most lucid-thinking and writing engineers of England. In 1843 John Weale published a book entitled "Ensamples of Railway Making," in which he draws a comparison between the cost of an American railway and an English railway, showing that, while one cost £3,600 per mile, the other cost £30,000 per mile. Mr. David Stephenson wrote a book called "Civil Engineering in North America," in 1838, and jotted down many interesting and instructive things. Mr. Isaac, Mr. Pasavant, Captain Douglas Galton, R.E., Sir Charles Hartley, Mr. Neilson, Sir H. W. Tyler, and a number of other clever English engineers have written most instructive papers on the railway system of America, and pointed out in forcible terms the merits of many things and ways as practised here to their professional brethren in England, and urged their adoption; but they may as well have saved their pens, paper, and patience, for their recommendations were as so much water poured on the sand. I intend to refer again to

* The engines referred to had three pair drivers coupled. Weight on coupled wheels, 25·9 tons; diameter of wheels, 49 in.; cylinders, 18 in. x 24 in.