1879.
NEW ZEALAND.

AMERICAN AND ENGLISH LOCOMOTIVES

(CORRESPONDENCE RESPECTING THE RELATIVE MERITS OF).

Presented to both Houses of the General Assembly by Command of His Excellency.

No. 1.

The Agent-General, London, to the Hon. the Colonial Secretary, Wellington.

Sir,— 7, Westminster Chambers, London, S.W., 6th November, 1878.

I have the honor to enclose, for the information of the Government, copy of a communication by Mr. R. M. Brereton on the subject of the superior working results of American locomotives as compared with English railway experience, together with an extract from a letter written by Mr. W. W. Evans to Mr. Higinbotham, Engineer-in-Chief in Victoria, relating to American engines.

I have, &c.,
Julius Vogel,
Agent-General.

The Hon. the Colonial Secretary.

Enclosure 1 in No. 1.

Mr. Brereton to the Agent-General, London.

Dear Sir,—

I have the pleasure to send you the following statements in reference to the superior working results obtained from American locomotives as compared with our English railway experience. I can guarantee the correctness of the statements, as they have been a source of careful observation and study by me during the past eight years.

During the past twenty-six years I have spent fourteen years in India in the construction and working of one of the principal guaranteed railways, besides four years in this country, and nearly eight in the United States, so that I am able to compare the working results in each country from the standpoint of experience. I have come to the conclusion that we can and ought to construct, equip, and work our railway system in India, in our several colonies, and in this country too, in a far more economical manner than past experience *here* has shown to be possible, or our consulting engineers, managing directors, and agents (who have not had the opportunity of studying the working of the 77,470 miles of railway of the United States) have hitherto believed to be possible.

In regard to locomotives, the Americans certainly obtain from 8,000 to 10,000 train-miles greater duty per annum than we can in this country or in India, and this too under the following drawbacks: Inferior roadbeds, steeper gradients, sharper curves, more severe climate, heavier loads hauled, and less speed in running.

The greater duty obtained cannot be due to better workmanship and superior materials, because it is well known that the English mechanic in skill of hand cannot be excelled, and the very best materials are employed by our English builders, and the hours of work in both countries are nearly the same. Hence, I argue that the greater duty done by the American motor is due to the better design and the better system of working the locomotives. The American builder excels in the system of framing and counterbalancing, and in the designs of the crank, axles, &c., so that the engine may run remarkably easily and without jar round sharp curves, and work not only the light roads, but also diminish the wear and tear on the solid roads, and, at the same time, increase the effective tractive force.

The English engine is a very heavy affair, and, in running, it not only wears and tears itself very rapidly, but also the roadway, and it greatly, by its unsteadiness and jar, fatigues the drivers and firemen. I have ridden hundreds of miles on engines in India, in England, in France, and in the United States, and I have always found the American engine most easy and comfortable, but I never did the English or the Continental engines. As an evidence of this unsteadiness in English-built engines, I may quote the following from the *Railway Service Gazette re* "Narrow-Gauge Engines in India:"—

"The speed on all narrow-gauge lines in India is restricted to fifteen miles an hour, and to run trains on our 3 ft. 3 in. gauge railways at a much higher speed is not safe, owing chiefly to the unsteadiness of the locomotives employed. The wheel-base is rigid, the whole engine is stiff, and, the weight not being equalized, through these and other causes they are very unsteady, the oscillation is very great, and the rigid wheel-base jars going round the sharp curves of the metre gauge. It is also almost impossible to give these engines their full hauling power, simply because the greater portion of the weight cannot be thrown on the driving-wheels."

Another point I have to make is the mistake we make in adhering so obstinately to our old-fashioned system of running the engine with only one crew. Every one who understands the construction and powers of the engine must see that it is capable of a far higher average annual duty than 16,000 to 20,000 train-miles. The engine should be kept in steam as long as possible, in order to avoid the wear and tear due to expansion and contraction which ensue under the present system of daily drawing the fires. The continuous running system would save considerably the present consumption of fuel in the daily getting up steam. They do not find in America that the double-crew system involves any greater cost in repairs and renewals: indeed the life of their engines compares most favourably with the life of engines in this country and on the Continent.

The duty of the driver is to run his engine and keep her in order on his daily trip from depôt to depôt; he has nothing to do with her in the stable or depôt; there she is cleaned, repaired, and got in steam by other hands employed for that purpose. When one crew have taken the engine over their daily stage another crew run her on, and so they oscillate to and fro, the engine stopping only for repairs and to be washed out. Mr. Juland Danvers's report for 1876–77 shows (on page 11) the number of engines on the whole of the guaranteed railways in India to be 1,425, and (on page 31) that the train-miles were 21,609,411, which gives an average of only 15,164 miles per engine. Deducting say 33 per cent. from the days of the year for the monsoon season, and for repairing-days, there are then 240 days in which the engine should be capable of running 100 to 200 train miles per 24 hours, or from 24,000 to 36,000 train-miles per annum. Mr. Danvers's report, however, shows that the average mileage per engine was only about 60 miles per 24 hours for, say, 240 days.

From the official returns of the New York Central Railway I find that thirteen of the engines in 1877 made a combined monthly average of 6,238 miles for the entire year; four of these ranging from 7,104 to 7,218 miles per month, while the average for the year of all the 97 engines in service was 38,422 miles per engine. One engine in 15 months averaged 7,858 miles per month, or over 255 miles daily for 461 consecutive days, including Sundays. The total life of these thirteen engines was 98½ years, which gives 39,948 miles per annum for each engine for their entire life. The cost of these engines in repairs per mile run was 27·10 per cent., which is equal to less that $1\frac{1}{10}$ pence per mile. Mr. Ely, the Locomotive Superintendent of the Pennsylvania Railroad, gives the following data in reference to twenty of their engines on the heaviest portion of their system over the Alleghany Mountains for the year 1877:—Ten passenger engines' average annual mileage was 45,554⅕, and cost of repairs per mile run was 3·48 cents; ten goods engines' annual mileage was 2,574⅕, and cost of repairs per mile was 3·65 cents; general average of all twenty engines was 39,065½ miles per engine, and cost of repairs per mile run 3·56 cents. One of their passenger engines, No. 133, averaged 237½ miles daily for an entire year (1872). This engine ran, in 1869, 44,616 train-miles; in 1870, 42,900; in 1871, 54,139; in 1872, 86,724; in 1873, 41,979; and in nine years' run it averaged 47,528 per year. Another of their passenger engines, No. 914, ran, in 1874, 60,604 train-miles; in 1875, 58,344; in 1876, 57,225; in 1877, 49,257. A goods engine, No. 447, ran, in 1870, 41,184 train-miles; in 1871, 44,108; in 1872, 42,537; in 1873, 36,877; in 1874, 35,580; in 1875, 36,508; in 1876, 45,529; in 1877, 39,193. This makes an average of 40,189 miles for each of the eight years this engine has been running. On the Erie Railway, Mr. H. J. Jewett, in an official letter, dated 8th April, 1878, gives the following mileage of four engines built by the Rogers Locomotive Works, of Paterson, New Jersey:—

	Mileage.	Placed in Service.
Engine No. 201	635,169	9th June, 1854
Engine No. 202	632,548	26th June, 1854
Engine No. 203	658,548	15th July, 1854
Engine No. 204	539,186	29th July, 1854

These engines had new boilers in 1871, the original boilers running seventeen years. He reports these engines good for eight years' more service at least. He also reports two other Rogers engines, No. 313 and 327, as running with their original fire-boxes since 1865, or thirteen years. The above-mentioned mileage gives an average for the twenty-four years of 25,677 miles per engine. You will observe that these engines on the different railroads must have been well constructed in the first instance, that they could not have been long in the repairing shops, and that they must have been kept in good running order notwithstanding the high duty they actually performed. This is really very remarkable, when you consider the very severe winters of the Middle States, and how destructive snow is to machinery, as well as Jack Frost, when it breaks up in the spring.

In order to arrive at a fair comparison with the cost of repairs in England, there are a number of points which should be equated, such as cost of labour and materials, effects of climate, steeper gradients, sharper curves, and heavier loads hauled, as in all these the American engines labour under greater disadvantages than engines in this country or in India. The Americans economize far more than we do in the first cost, and in repairs and renewal, by adopting a system of interchangeability of parts as much as possible, and by limiting the number of types or classes of engines. It may be said that for all ordinary traffic requirements of any railway system three types are sufficient. The Americans have perfected the three classes known as C, D, and E. Class C is for passenger service, and for level lines, or where the gradients are easy; Class D, known as the "Mogul," for goods and for heavy gradients; Class E, known as the "Consolidation," for roads having exceptionally heavy gradients, or a very large traffic to be hauled. The passenger engine has a four-wheeled truck, which not only swivels, but can move laterally under the front end of the engine by means of a swinging bolster; it can adapt itself to the shortest curves in use on railways, and to the greatest inequalities in the road. The four driving-wheels are equalized together, as also are the four truck wheels. In the goods engine the same arrangement for swinging trucks is found. The truck is composed of only one pair of wheels. On the Lehigh Valley Road, where there is a heavy coal traffic, gauge 4 ft. 8½ in., Class E works over maximum grades of 126 feet per mile, with a maximum load of 329 gross tons of wagons and loading, and the usual load is 235 gross tons. On a gradient of 76 feet per mile, one of these engines draws a maximum load of 140 empty four-wheeled wagons (476 gross tons) at a speed of eight miles per hour. The usual train is 100 wagons (340 gross tons) on an incline three miles in length, with a gradient of 96 feet per mile, combined with frequent curves of 8 and 10 degrees radius, and with only two tangents, each less than a mile long. Engines of this class (E) take forty loaded four-wheeled wagons, which are hauled at a speed of twelve miles per hour. The wagons weigh each 3 gross tons 8 cwt., and carry each six gross tons of coal; so that these engines haul up the above incline a train weighing from 329 to 376 gross tons. They consume 3¾ tons of coal daily.

On the Denver and Rio Grande Railroad 3-ft. gauge, where the maximum gradients are 4 per cent. or 211 feet per mile, and the sharpest curves 30 degrees or 193 feet radius, and where the rise in 14·7 miles is 2,370 feet, and in 10·8 miles 1,136 feet, this class (E) of engines hauls one luggage-van and seven passenger carriages, containing 160 passengers, weighing 100 tons, stretched over a length of 360 feet.

On another narrow-gauge road where the maximum gradient is 140 feet per mile, 3 miles in length, combined with several curves of 574 and 478 feet radius, one of 338 feet, and several reverse curves of longer radius, the regular load of these engines (Class 10/24 E), at a speed of 12 miles an hour, is fifteen coal wagons, weighing 9,500 lb. each, with passenger carriages weighing 18,000 lb., making total load, exclusive of tender, of 81¼ tons. On gradients of 52·8 feet per mile, the usual load is 27½ tons of 2,000 lb. As regards train-mileage, the following comparative statement, showing working results on English, American, and Indian railroads for the year 1876-77, will prove interesting and instructive:—

	No. of Engines.	Miles operated.	Train-miles per engine.
English.			
Great Western	1,478	2,274	17,397
Great Eastern	505	907	20,600
Midland	1,326	1,588	18,219
London and North-Western ...	2,058	2,158	15,800
	5,367	6,927	4)72,016
		Average of all ...	18,004
American.			
Pennsylvania	515	*1,071	32,627
New York Central	602	†1,000	30,870
Michigan Central	219	804	30,812
Erie...	468	956	26,900
	1,804	3,831	4)121,209
		Average of all ...	30,302
Indian.			
East Indian	450	1,504	14,737
Great Indian Peninsular ...	331	1,288	17,000
Madras	100	858	23,334
Bombay and Baroda	64	417	19,149
	945	4,067	4)74,220
		Average of all ...	18,555

The above shows 12,298 more train-miles per engine for American roads than for English, and 11,747 than for Indian roads. The following statement shows the average cost of locomotives on four of the English roads, and the average cost of American engines:—

English.		American.	
Midland	£2,648	1st Class Passenger Engine (C) ...	£1,720
Great Eastern	2,271	1st Class Goods Engine (D) ...	1,800
Great Western	1,767	1st Class Goods Engine, extra power (E)	2,300
London and North-Western... ...	1,617		
	4)8,303		3)5,820
Per Engine	£2,076	Per Engine	£1,940

Mr. Danvers's report does not show the cost of the English engines erected ready for service in

* On the Pennsylvania Railroad, including the double and third lines, the aggregate number of miles operated by the 515 engines was 2,881.

† On the New York Central the same was 2,433 by 602 engines.

India. I am confident that American engines will cost no more, if so much, as the freight from New York to Bombay, Madras, and Calcutta is nearly the same as from Liverpool, say 40s. per ton.

I find, from the official reports of the Colony of Victoria, that the American locomotives built for the Government Railways by the Rogers Locomotive Works of Paterson, New Jersey, cost, erected in Melbourne, £2,132 each; whereas those built in England, and erected in Melbourne, cost from £2,352 to £3,032 each, and those built in the colony itself cost erected from £2,939 to £3,571 each. The American engines for the Colony of Victoria, and for the New Zealand Government railways, were ordered through Mr. W. W. Evans, Mem. Inst. C.E., who has an office in New York, at 66½, Pine Street. They were built and shipped under his direction entirely. The best American narrow-gauge engines cost, delivered f.o.b. in New York, as follows:—

1st Class Passenger (C)	£1,500 per engine.
1st Class Goods (D)	£1,600 per engine.
1st Class Goods, Extra (E)	£1,700 per engine.

Mr. A. Morris, Executive Commissioner (to the Colony of New South Wales) to the Philadelphia International Exhibition of 1876, reported to his Government that American engines of the very best quality could be laid down in Sydney for £2,000, or £1,000 less than for those contracted for in England. Mr. Allison D. Smith, the Locomotive Superintendent of the Government railways of New Zealand, wrote on the 29th March, 1878, as follows, in reference to the American engines which Mr. Evans had sent out to that Government: "The engines or 'Yankees,' as they are called here, are working splendidly; they have given great satisfaction. I have picked out our best men for them, and they are great favourites. When I let it be known that six more were coming, the drivers and firemen all commenced to vie with each other in trying who should be best man in order to get one. The engines, being new, are somewhat stiff, but I can plainly see that they will be economical in stores, and light in repairs."

Now, if the best American engines can be laid down in India and in our colonies as cheap or cheaper than English engines, and that they will run easier and with greater steadiness, involve less expense in repairs and renewals, and do less damage to the permanent way, it is surely worth while for consulting engineers, directors, and agents to consider the economy their introduction must occasion.

At the same time I must say it would be better if they were never ordered than to place them at the disposal of any prejudiced or narrow-minded superintendent, who would be sure to injure them and give them a bad name, as was done in South America. In the hands of an intelligent and liberal-minded superintendent, I am confident they will prove far more effective and economical than our Indian and colonial experience has hitherto found to be possible with English engines.

The two best and most reliable locomotive firms in the United States are the Rogers Locomotive and Machine Works and the Baldwin Works. Both have immense establishments, tools, and appliances for turning out with the greatest expedition a large number of engines, surpassing any similar establishment in this country. The former firm are noted for their care in packing their engines for export, so that their engines always arrive in excellent condition and free from rust. Mr. W. S. Hudson, the superintendent of the works, is an Englishman by birth, and as a lad was brought up on the Stephensons' works at Newcastle. He is now recognized as the ablest locomotive-builder in the United States, and he is as good a master of natural and mechanical sciences as can be found in America, although almost self-taught.

The Baldwin Works have a more extended reputation than the Rogers, for they have agents and travelling partners everywhere, and their engines are excellent; but it is admitted by all the best experts with whom I have come across that those engines which are built under Mr. Hudson's own eyes and which have his brains on them are superior to all others.

I am surprised to find how slow we are in this country, in India, and also in our colonies, in adopting the Westinghouse automatic brake, the Miller's coupling and buffer to passenger carriages, which entirely prevents telescoping in collision, and the cast-iron chilled wheel made of the Salisbury iron of Connecticut, all three of which railway appliances are now in general use in the United States. In my judgment no railway train can be *safely* worked in these days without the Westinghouse brake, and to pause in adopting it simply because of the possibility of something better being discovered is no valid reason, while the lives of passengers and valuable property are in daily jeopardy. It should be remembered, on the principle that "the proof of the pudding is in the eating," that the Americans are the most experienced railway managers in the world, as they have upwards of 74,000 miles in daily operation, 3,000 miles of which are narrow-gauge lines, and that on the majority of their roads these three railway appliances are adopted and have been in use for years. I believe if we adopted the use of the cast-iron chilled wheel we should effect an immense saving. These wheels have a life of 100,000 miles, and cost only £3 10s., as against £7 to £9 the cost of the English steel-tired wheel. The weight of a wheel for a passenger carriage is about 525 lb. The metal is charcoal iron, having a tensile strength averaging 14 tons per square inch. When you compare the life and first cost of these wheels with those you have in use in this country, in India, and in the colonies, I think you must be struck with the financial importance of the result.

Another most useful and handy machine in general use in America, especially on the Western prairies, where fuel is scarce, is the Corcoran wind machine for pumping. I think it is the most perfect wind motor ever invented. It is used in connection with cedar tanks, holding from 50,000 to 150,000 gallons, for supplying the engines. The machines are entirely automatic. They set themselves to the wind, and turn their face from it when it blows too hard; they can be regulated to any strength of wind, and will work in the lightest zephyr.

The cedar tanks, if properly covered, last fifty years and upwards. By soaking the staves in silicate of soda, and then in chloride of calcium, they can be made to last for a very long period.

In India we have only about 7,000 miles of railway to a population of about 200,000,000. In the United States they have 77,470 miles to a population of 45,000,000. The railways in the United States have cost on the average for construction and equipment about £12,000 per mile, and some of the principal and best roads, like the New York Central, have cost only £9,000 per mile, and their narrow-gauge roads, 3 feet to 3½ feet gauge, £4,000 to £6,000 per mile. In this country we know that the cost has been £37,433 per mile, and in India, £15,760; the East Indian cost £20,365, and the G.I.P. £18,000 per mile.

In the future construction of railways through villages and plains, where alluvial soil exists, in which the common plough will operate, and where horses, mules, and bullocks are available, an immense economy in cost of earthwork may be effected by the use of the American "Wauchope," and the "Sleessor" earth-excavating and moving machines, and also with the Chicago self-revolving scraper, all of which are very largely employed in the United States. I have used them myself on very large works in California, and with labour at 12s. per diem, and horses on hire at 6s. to 8s. per pair, I have moved earth into embankments at the rate of 1,000 cubic yards a day with the "Wauchope," and at the cost of under 1d. per cubic yard.

Many people are inclined to believe that labour is cheap in India, because they get into the way of comparing it with English and European labour; but in reality it is not cheap for India, when the limited wants and frugal fare and habits of the people are considered, as well as the vast amount of earthwork yet to be done in that country in railroads, canals, &c., and the very limited capital at the disposal of the Government.

Another great economy effected in railroad construction in America is in the adoption of the "Whipple" truss bridge. The English engineers of the railways in Canada have gone to the United States for their large-span iron bridges, because they have found that they could not get as good for the money elsewhere, notwithstanding that the American iron is charged 17½ per cent. duty in entering Canada. Messrs. Clarke, Reeves, and Co., of Philadelphia, have built and erected over three miles in length of their "Whipple" truss bridge on the Canadian Railway, besides nearly nine miles of similar bridges in the States and in South America. The iron they use is made from the ore found on their own premises, and this iron has always shown a much greater tensile strength than the best classes of English iron in the market, and may safely be taken at 30 tons per square inch for tension, whilst their patented Phœnix columns have been proved to have a resistance to compression which has never been obtained before.

The facility and rapidity with which these bridges are erected appears almost incredible to the English engineer, who is practised only in the English rivetted girder work. I have known spans of 150 feet erected in a single day of eight or nine hours. As a rule, the rivetted work takes just as many weeks to erect as the pin-connected work takes days. The advantage of the pin-connection, besides being the most scientific and proper, is that all the skilled work is done in the shops, and none on the scaffolding during erection, so that the work of erection goes on with a facility and rapidity utterly impossible in a rivetted structure.

The pin-connected work is also cheaper than the rivetted, because there is less metal in it. In proportioning the different parts, the strength of each part is increased in proportion to its nearness to its work, so that, in carrying out the principle of "uniformity of strains," the American structure is of the strongest combined with the lightest, and thus there is no useless weight of iron to be paid for. They have been proved for years under the heaviest railway traffic, and found thoroughly safe and efficient. All the parts, being made by machinery, are of exact uniform dimensions in similar spans, and are therefore perfectly interchangeable. This greatly facilitates the erection and the rebuilding of these bridges.

I believe that these American bridges, of spans not under 150 feet, can be laid down and erected in India and in our colonies considerably cheaper than English bridges.

I have, &c.,
R. M. Brereton.

Sir Julius Vogel, K.C.M.G., &c.

Enclosure 2 in No. 1.

Extract from a Letter of Mr. W. W. Evans to Mr. Thomas Higinbotham, Engineer-in-Chief of the Victorian Railways, Australia, dated 3rd March, 1878.

Locomotives.

I note what you say about them, and that those I sent were doing good work. I was much pleased to find that you were running them on heavy work. I ought to have sent with them two sets of valves. I think we could arrange a set of valves for those engines that would save when working on heavy traffic another two pounds of fuel per train-mile. There is another engine invention come out, which will work wonders if all that is claimed for it is true. I will send you a circular. A Mr. Bonta drives his fires with a blower, the blower of a steam cylinder. The gases in the engine are kept under pressure 1½ to 2 pounds per inch. The cinders are received in a box under the engine; the exhaust pipes are left open full size to prevent any back pressure in cylinders. The exhaust heat is used only to heat the feed water. The inventor, a modest man, says he has been running an engine with his invention in it for six months, and that it has beat the other engines on same road in New England 25 per cent. in the fuel account. He does not claim 25 per cent. saving, but wishes to have the thing thoroughly examined by experts. I have long thought of the merits that would result from keeping the gases under pressure in an engine if it was for only one second longer, so as to get more time for chemical reaction.

You say there is a prevailing impression that the American engines will not last over five to seven years. I propose to give you a few figures on this matter to show to those interested in such things. I some years since saw in an English paper, the *Railway News*, a statement of the mileage of engines in England. I was so astonished at the small figures that I sent and got some data of English and American engines, so that I could compare them. This was in 1874. The figures were as follow for 1873, and give averages for the year of all the engines they had:—

English Railways.	Miles.
London and North Western	15,415
Midland	18,808
North Eastern	17,290
Great Western	18,320
	4)69,833
Average of all	17,458

American Railways.	Miles.
Boston and Albany	24,500
Erie	27,550
New York Central	26,933
Pittsburg, Fort Mayne, and Chicago	31,737
	4)110,720
Average of all	27,680

The above gives an average of 10,222 miles for the American engines more than for the English. This is decimally 58 per cent. greater duty, and it was done on inferior tracks, in a more severe climate, over steeper gradients and sharper curves, and with heavier loads. It must be admitted in making this statement that the English engines no doubt showed a greater average speed than the American, but, with this admitted, they should show greater average mileage in the year.

Let us look at some more average mileages in 1876. The Illinois Central Railway had 202 engines. They averaged 27,819 miles in the year. See *Engineering*, March or May, 1876. In 1875 the Central Pacific Railway had 203 engines; they ran 5,676,030. This gives an average of 27,960 miles. The report of the Missouri, Kansas, and Pacific Railway for 1876 gives the engine mileage of that railway as averaging 37,811. *Engineering* for November gives mileage of that railway as averaging 37,811. *Engineering* for November 10th, 1871, pages 305 and 310, gives the average mileage of engines in England on twenty railways for six months as 9,168 miles; this for the year is 18,336. *Engineering* for May 11th, 1877, gives the average mileage of twenty-two railways in England in 1875 as 17,934. In McDonell's paper, No. 1469, on the repairs and renewals of locomotives, read before the Institute of Civil Engineers, January 16th, 1877, there are many statistics in relation to locomotives worthy of close study. On page 68 he gives the half-year mileage of twenty railways in England to July 31st, 1876, the average being 881,207 for the year. This gives 17,625. Facing page 35 he gives a table of mileage of 176 engines on the Great Southern and Western Railway of Ireland, which shows an average mileage for ten years of only 13,926. On page 41 he makes out that these 176 engines would last 11·95 years, running 20,000 miles a year. On page 49 he says the average age of the Great Western engines was 6·1 years. On page 74 the President, in his closing remarks, says, "Many engines had been killed earlier than they ought to have been, because the traffic had increased faster than the engines to keep pace with it." He also says on page 75, referring to the North-Eastern, "That company had scarcely a spare engine. The engines were at work day and night." Now, if this was the case, that the engines were at work day and night, I cannot understand how they came to have such low average mileages in a year as 17,000 to 18,000, particularly as the loads are light, the roads good, and the speed high.

The report of the Pennsylvania Railway for 1874 shows the average of all their 786 engines, passengers and freight, to be for the year 25,263. One of these engines, No. 133, on Middle Division, is put down in this report as having run in the year 83,820 miles, on passenger trains. They give the largest run of any engine on each division. Thinking this might be an error, I wrote to Mr. Ely, the Superintendent of Motive Power, to ask if he would confirm this tremendous run. He wrote me that this engine not only ran the 83,820 miles as reported on passenger trains in 1873, but ran 2,904 on freight trains. This makes 237½ miles a day for every day in the year, and is much the largest run I ever heard of. You may depend on it that engines that can perform such duty are not toys or flimsy things. Taking 17,500 miles as the general average of engines in England, this mileage shows that this engine, No. 133, did 5½ years in one.

This same report shows that a freight engine, No. 215, on the same division, ran 48,012 miles in the year. The Pennsylvania Railway does not give me the age of the engines or data to get it; but the Reading Railway does. They give No., class, weight, maker's name, date when first run, miles run in the last year, total miles run, and service employed on. I will give you a few figures from the company's report of 1875, giving data up to the end of their official year, 30th November, 1874, when they had 403 engines:—

No.	Class.	Weight in Tons of 2,240 lb.	When first run.	Miles run in Year 1874.	Total to Date.
23	1st	26·9	July, 1852	24,780	410,733
44	1st	26·2	May, 1857	25,484	438,541
45	1st	23·8	June, 1857	27,428	422,222
49	1st	25·2	Aug., 1857	28,593	475,733
57	1st	25·2	June, 1859	35,407	426,071
58	1st	25·2	June, 1859	35,142	455,428

The above-named engines were all built by the Reading Railway Company, at their own shops;

they were all passenger engines; they had been running from fifteen to twenty years, and you will see that each of them did a large service in 1874. Taking 17,500 miles as a fair yearly average, these engines had been doing the equivalent of twenty-three to twenty-six years. I do not give the above figures as averages in any way. I selected them as giving large runs for the last year, and large totals. Some of their engines have five pair of drivers coupled that can run without complaint around curves of 600 feet radius: we have five of such engines on the railways of the Consolidation Coal Company of Maryland, where I have a large interest, and was for years a director. They do us good service, haul immense loads cheaply, and are easy on the track. I sent a photograph of this class of engines to the Institution of Civil Engineers. When Mr. H. Coneybeare, a member, was here, he told me the gentlemen of the Institution in Great George Street thought these engines were a "myth." I took him over to the Reading Railway, and showed him they were not a "myth." I placed him by the side of a curve—the sharpest there—600 feet radius, and told him to note that these engines run the curve without a squeak or groan.

You are right about the engines looking light, but they are not so in reality. They can and do do their work, and live to an old age. Don't fear their living only six to seven years. Much of the life of an engine depends on various circumstances, such as having a good driver, good water, fuel without much sulphur in it, a good track to run on, mild climate, repairs when required, not overloaded and the fires not urged to their utmost, moderate speed, &c., &c. All these things tell on an engine.

No. 2.

The Engineer in Charge, North Island, to the Hon. the Minister for Public Works.

Public Works Office, Wellington, 18th January, 1879.

Re comparative merits of American and English locomotives, as set forth in Mr. Brereton's letter, and forwarded by Agent-General.

This communication has been carefully read and considered, and I herewith forward a memorandum, prepared by Mr. Maxwell, which will be found to place the matter in a light very different from that imparted by Mr. Brereton's letter.

Further information on the whole subject will be obtained hereafter and laid before you, but I think sufficient grounds will be found in the accompanying memorandum to warrant the continuance of orders for locomotive engines being sent to England: not necessarily to the exclusion of orders for American engines, which, doubtless, will be found to answer well on certain lines and under certain conditions. In reference to the length of time which elapses after giving an order for engines in England before the receipt of the engines here, I may venture to offer an opinion, and to express it strongly, that sufficiently prompt action is not taken by the Home Consulting Engineer on receipt of an order, but that much time is needlessly lost. There is no possible reason why large English firms, with all necessary appliances, with which most of them are equipped, should not turn out locomotive engines as speedily as the American makers.

The Hon. the Minister for Public Works. John Blackett.

Enclosure in No. 2.

The District Engineer (Unattached) to the Engineer in Charge, North Island.

Public Works Office, Wellington, 16th January, 1879.

Mr. Evans's and Mr. Brereton's letters contain but little information which conveys any practical intelligence to a professional man which would permit him to give a verdict on the respective merits of the engines. They contain some vague generalizations which are calculated to mislead an unprofessional man. The subject is taken up as though it were new and previously undiscussed: it has, however, formed a subject of minute examination by some of the best engineers in both countries for years past.

The data necessary to enable a professional man to judge and to compare would comprise—the gross weight of the locomotive in working order, the adhesion weight of same, diameter of cylinders, stroke of piston, diameter of driving-wheels, wheelbase and particulars, tank capacity, coal capacity, particulars of boilers, heating surface, &c., working pressure, the cost of engines, the cost of running them, the engine mileage, the data showing how the engine mileage is computed, the character of the gradients, curves, and gauge on which the various classes were required to work. Then any particulars as to the average performances would be of some service; but without such data no locomotive engineer would pretend to offer an opinion.

Amongst some of the general and vague statements in Mr. Brereton's letter to which exception may be taken are as follow: Speaking of America, he says they have "steeper gradients, sharper curves, more severe climate, heavier loads hauled, and less speed in running." He classes these as drawbacks in obtaining a large train-mileage; but that low speed is a drawback is a very questionable assertion.

As regards gradients and curves, English lines show every gradation from the Festiniog (1 ft. 11½ in. gauge), which has curves 1¾ chains radius, and the Monmouth and Blaenavon line, with 1 in 42 gradients and 6-chain curves, up to the first-class lines with no curves sharper than 30 chains, and seldom under 60 to 80, and gradients not steeper than 1 in 100.

Mr. Zerah Colburn, an American engineer of considerable eminence, and a most able writer on this subject, in a paper on American locomotives read before the Institution of Civil Engineers, London, in 1869, says, "What are now understood as steep or exceptionally steep gradients are rare in the States." No doubt since 1869 many lines with steeper grades have been constructed, but these particulars suffice to show the fallacy of the generalizations regarding curves and gradients; and, as regards loads, Mr. Brereton quotes no data available for comparison.

Again, Mr. Brereton says, "The English engine is a very heavy affair," &c., and quotes from a newspaper, "The wheel-base is rigid; the whole engine is stiff," &c. There can only be one inference to be drawn from this by an unprofessional reader—viz., that all English-built engines are alike, and are rigid, stiff, and undesirable, and that all American-built engines are the reverse.

It would be unnecessary to remark to a professional man that the English-built engines comprise machines of various types—there are light engines and heavy engines, with long rigid wheel-bases and with short and flexible wheel-bases—and that American-built engines show the same diversities.

The English-built engines vary from the Fairlie, with a rigid base of 5 ft., or a contractor's tank-engine with about the same, and the Adams or Bissel-Bogie fitted stock, up to the London and North-West goods engine, with a 15 ft. 6 in. base, and in weight from eight tons up to fifty tons. The American locomotives will exhibit similar divergencies, and consequently such a generalization as I have quoted is unreliable.

The American Bogie engines of the type we have in New Zealand, with small rigid wheel-base, are, as stated, well suited for bad roads and for sharp curves, but they do not present special advantages for working steep grades. That American engines are not always found most suitable, is practically illustrated by the case on the Iquique Railway, Peru, a line with long gradients of 1 in 25, where Mr. Evans's engine was found to be less successful and more costly to work than the English Fairlies, which are now exclusively used, the American engine being abandoned.

The statements to support the views that American are superior to English-built locomotives are as follow: 1. That the American obtain a larger train-mileage. 2. That the first cost of the American is lower.

Of the first statement I may say it is put forward without a single qualification; and the inference that generally the American engines are 50 per cent. superior to the English is quite erroneous.

There are many different ways of computing train and engine mileage, and with the same amount of running different computers would produce widely differing statements. To compare the train-mileage of two countries in so crude a manner is therefore manifestly erratic.

There are, besides the method of computing, other reasons why the Americans show a larger train-mileage. Mr. Brereton points out one—it is that Americans run continuously and so obtain a greater mileage; the English practice in running places the locomotive at a disadvantage as compared with the American, but this has nothing to do with the efficiency of the machine.

Again, the English averages extend over a greater number of years and take in a large number of old engines. More recent averages give a much higher result. For instance, three years running of single Fairlies on the Great Southern Railway of Ireland showed 25,000 train-miles as an average. The London and South-Western Railway, England, for the six years ending 1874, was working with an average of 25,000 train-miles.

In this colony the English-built engines were working from 25,000 to 30,000 miles a year. It is not, however, rational to make general comparisons without specific data.

In framing the form of statistical returns for locomotives in New Zealand, I consulted Mr. Conyers, and he determined the method of computing the train-mileage, and agreed on the other statistical statements, and the returns on this basis are now rendered to the Commissioners by the Managers, and they contain every information necessary. As there are two American engines, constructed under Mr. W. W. Evans's supervision, now running in the South under somewhat similar circumstances to the English-built, they may *to some extent* be compared, and Mr. Conyers could readily furnish the data for comparing working statistics: such data, however, must be, even then, received with great caution, because long average periods are necessary to eliminate accidental features, and the number of engines will largely affect the results.

As regards the statements made by Mr. Brereton about cost, I am not exaggerating when I state that the values of a cart-horse and a racer might as reasonably be taken to draw inferences from, as to the respective merits of the animals, as might his figures in the absence of data. I will compare the first cost of an American engine now working in Christchurch with an English engine also working in the district. They are alike in some respects, but not intended for the same service. They are both tender engines, and each have eight wheels, are about the same weight, and approximately the same cost each, and the adhesion weight and cylinder-power are in like proportion in each. The American has four-wheels coupled and two bogies; it cost erected in New Zealand about £2,800. It has a tractive force for each effective pound of pressure of 60 lb. The English engine has six wheels coupled, and one bogie; it cost erected in New Zealand about £2,700. It has a tractive force of 93 lb. for each effective pound of pressure. The comparative cost of the two engines, based on their efficiency for traction, will be—for the American, £46 6s.; for the English, £29.

The English engine is much superior on lines with steep grades and moderate curves, and is much the cheaper. It would not, however, be suitable for the service for which the American is designed, which is a faster engine, nor would it work so satisfactorily on sharp curves. The comparison is not, therefore, worth much except to show how very fallacious are Mr. Brereton's general statements, and when you compare the cost of the American engine (£2,800) with the average cost given by Mr. Brereton (£1,500 to £1,700), it shows still more the necessity for requiring specific data for judging from. The cost of some of the types of engines working in New Zealand is as follows:—10-inch cylinder double Fairlie, £3,200; 14-inch cylinder Christchurch goods, £2,700; 12-inch cylinder American passenger, £2,800; 10½-inch cylinder six-wheel coupled, £1,500; 9½-inch cylinder four-wheel coupled, with bogie, £1,300; 8-inch cylinder four-wheel coupled, £1,000.

The Americans cannot compete with the English in cheapness, or in the class of work they turn out.

These remarks are not intended to depreciate the merits of Mr. Evans's engines, of which there are now eight working in Christchurch. Mr. Carruthers recommended the importation of two on trial, and Mr. Conyers was so far satisfied with them as to recommend obtaining six more. This is a sufficient evidence that those imported to New Zealand were found to answer the purposes for which they were required, and to show that their merits are appreciated. It is, however, desirable that unqualified statements of the universal efficiency and superiority of American-built locomotives should not be circulated without comment, as they are apt to mislead. The class of locomotives required on a line will always have to be determined by the features of the line, the kind of traffic, and the rate of speed demanded.

The Engineer in Charge, North Island. J. P. MAXWELL.

No. 3.

The AGENT-GENERAL, London, to the Hon. the COLONIAL SECRETARY, Wellington.

SIR,— 7, Westminster Chambers, London, S.W., 10th December, 1878.

I have the honor to enclose herewith copy of a correspondence between Messrs. Hemans, Falkiner, and Tancred, the Government Engineers, and Messrs. Neilson and Co., of Glasgow, and the Vulcan Foundry Company, which has arisen owing to the attention of the contractors being called to the remarks contained in the Appendix attached to the Public Works Statement of this year, relative to the comparative merits of American and English locomotives.

I have, &c.,
JULIUS VOGEL,
Agent-General.

The Hon. the Colonial Secretary.

Enclosure 1 in No. 3.

COPY of MEMORANDUM sent out by Messrs. HEMANS, FALKINER, and TANCRED.

GENTLEMEN,— November 25th, 1878.

As you have from time to time supplied locomotives for the New Zealand railways, we beg to direct your attention to the following paragraph which appears in the report of the Commissioner of Railways, addressed to the Minister for Public Works under date July 24th, 1878. With regard to the American engines the Locomotive Engineer reports,—

"They have now proved themselves to be both good and economical, and for attention to detail in design and general excellence in workmanship they stand out first in our catalogue of locomotives. American engines I thoroughly believe to be more suited for our lines than anything we can get built in England."

Enclosure 2 in No. 3.

Messrs. NEILSON and Co. to Messrs. HEMANS, FALKINER, and TANCRED.

DEAR SIRS,— Hyde Park Locomotive Works, Glasgow, 27th November, 1878.

We are in receipt of your esteemed letter of 25th instant.

We are neither prepared to admit nor deny the statement made regarding the merits of the American locomotives. We are, of course, quite ignorant of the design and details of the engines in question, and therefore cannot form an estimate of wherein they differ in these respects from the engines built by ourselves, and others for the New Zealand railways.

The ordinary American type of engine, such as is in use in America, is, we have not the slightest doubt, better adapted for railways as now constructed than the engine used in this country. It is more flexible, and adapts itself better to the line than our excessively rigid engines. It has also the advantage of being less costly, though, we quite believe, equally efficient in its details, by reason of these being of simpler construction and frequently of cheaper materials.

We need not tell you that, although holding these views, it would be needless our attempting to persuade our locomotive superintendent to adopt even a modification of the American type, as you will be well aware of the vast amount of prejudice that would have to be overcome.

While admitting that the American type of locomotive may have some advantages over those of this country, we must be allowed to protest against the assumption that they can only be made in America. This is a great mistake. We have ourselves been in competition with American firms for the supply of engines of the American type to an American railway, and secured the contract, notwithstanding that our cost for delivery on the rails was necessarily so much higher than that of our competitors.

We enclose photograph of this engine, No. 346.

Quite recently engines of our own design were accepted for a colonial railway in preference to American-made engines of American type; price having been an important consideration.

We enclose photograph No. 484 of engines recently constructed by us for South America, where American makers compete with us. You will observe that it is an engine of a modified American type.

We are prepared to make engines to any drawing and specification that may be submitted to us, and to enter into competition for the supply of the same with any American makers; and we undertake that our engines will give equal satisfaction, both as regards design of details and general excellence of workmanship with, and will prove quite as economical as, those made in America.

If you could for our private information give us a sight of the drawings and specification of the American-made engines on the New Zealand railways, we should esteem it a great favour.

We are, &c.,
NEILSON AND CO.

Messrs. Hemans, Falkiner, and Tancred.

MEMORANDUM.

We sent Messrs. Neilson and Co. a copy of the specifications of the engines lately made in America, with a request that they would consider confidential the prices and other details. We enclose their reply just received.

Trusting that this correspondence may be of interest and value to the Government,

We are, &c.,
HEMANS, FALKINER, AND TANCRED.

Enclosure 3 in No. 3.

Messrs. NEILSON and Co. to Messrs. HEMANS, FALKINER, and TANCRED.

Hyde Park Locomotive Works, Glasgow, 29th November, 1878.

DEAR SIRS,—

We are exceeding obliged by receipt of yours of 28th instant, enclosing specification of American engines, which we are having copied.

From the hurried glance we have taken of the specification, we can state that we would have been very glad to have taken the contract at a very much lower figure than Evans's price.

We have, &c.,
NEILSON AND CO.,
(per Thomas W. Chalmers.)

Messrs. Hemans, Falkiner, and Tancred.

Enclosure 4 in No. 3.

The VULCAN FOUNDRY COMPANY to Messrs. HEMANS, FALKINER, and TANCRED.

Lancashire, 28th November, 1878.

GENTLEMEN,—

We beg to acknowledge receipt of, and to thank you for, the memorandum you have been good enough to send us in reference to American locomotives in use on the New Zealand railways.

We must confess that we are not sufficiently cosmopolitan in our ideas to learn without feelings of sorrow that we may probably ere long be driven from yet another field of operations which we might naturally almost call our own.

Without inquiring too closely into the causes which have made a report so antagonistic to the interests of English manufactures possible, we should much like to know whether our transatlantic competitors built these particular engines to a specification and drawings supplied, or whether the design and carrying out of details was a matter left entirely to themselves.

We suppose the latter, in which case we submit the comparison between ourselves and the American builders is most unfair.

We are prepared to admit that the American type of engine—we allude particularly to the "bogie" principle, and more especially to the "Bissel" form of same—is certainly better adapted to the nature of the curves and permanent way usually prevailing in our colonies than the rigid wheel base of our English engines; but such is the absurd conservatism existing in this country that any departure from existing types would not be entertained, and we know that it is only within a comparatively recent period that any of our locomotive engineers would tolerate the "bogie" system on their lines of railway. If English builders are compelled to adhere to a particular type and specification of an engine, they surely cannot be held responsible for its performances or failures. So much for design.

In reference to "attention to details and general excellence in workmanship," we will couple these, and can only say that we have yet to learn that the palm has been wrested from our hands. On the contrary we are still under the impression, from all we have heard, read, or seen, that English work is not only equal but superior to that turned out by American manufacturers.

As to first cost, permit us to remark the American houses possess an immense advantage over us, from the simple fact of their being able to supply standard types, for which special appliances may economically be provided, whereas in this country every locomotive engineer is guided by and follows only his "own sweet will." This adhesion to a particular type also enables the producer to deliver engines at the shortest possible notice, which often is of paramount importance, and would frequently be the means of securing an order.

The American type of engine, specification remaining the same, could be built as substantial, accurate in workmanship, and we believe in quality, as cheaply in this country as in the United States of America.

We are, &c.,
THE VULCAN FOUNDRY COMPANY (LIMITED),
(per Edward Bretteth, Manager.)

Messrs. Hemans, Falkiner, and Tancred.