

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

REPORTS

ON THE

INDIAN RAILWAY GAUGE.

AS COMPARED WITH

THE GAUGES ADOPTED IN

GREAT BRITAIN AND IRELAND.

Calcutta:
PUBLIC WORKS DEPARTMENT PRESS:
186

Extracts from Reports of the Head Officials of the various Indian Railway Companies, on the relative advantages of the Indian gauge as compared with the English narrow gauge for Railways.

MADRAS.

No. 278, dated 15th October, 1864.

*Extract from a letter from—W. B. WRIGHT, Esq., Locomotive Superintendent,
To—Agent and Manager, Madras Railway Company.*

I beg to inform you that, in my opinion, the Indian gauge for Railway possesses decided advantages over the English narrow gauge.

2. The chief of these is the steadiness with which the vehicles composing trains run at high speeds over the Indian gauge, which steadiness, as compared with that of vehicles running at like speeds on narrow gauge Railways, cannot fail to be remarked. This is no doubt due to the greater breadth of the wheel base, and the increased stability due to this.

3. This gauge offers other advantages in the construction of locomotives, the greater breadth of gauge allowing of a broader fire-box and in cases of inside cylinder engines allowing greater width between the cranks; the cylinders can be kept lower than on the narrow gauge, thus giving the double advantage of a lower centre of gravity, and at the same time a broader base.

4. No one who has travelled on inside cylinder narrow gauge engines at high speeds, and on a similar class of engine on the Indian gauge can fail to observe the difference between their relative steadiness, and there can be no doubt but that the wear and tear both to permanent way and locomotives must be very considerable, in consequence of this oscillation on the narrow gauge, which is almost entirely done away with by the well proportioned engines and stock which the Indian gauge admits of.

5. The only advantage that the narrow gauge possesses is, that the stock can travel more easily round curves, but for all practical purposes the 5' 6" gauge is, in my opinion, the best gauge extant.

No. 570, dated 20th September, 1864.

*Extract from a letter from—W. G. SMART, Esq., Chief Engineer,
To—Agent and Manager, Madras Railway Company.*

PARA. 2.—In calling for the opinion of Railway officers on this subject, the Government does not, I imagine, contemplate the revival of the discussions known as the Battle of the Gauges which took place some 18 or 20 years ago, as they have access, no doubt, to Parliamentary evidence and other publications giving full and accurate information on all points connected with the question. The intention, I presume, is merely to obtain an expression of opinion based on observation of the merits of the Indian gauge. The only merit it appears to me to possess over the 4' 8" gauge is that it imparts greater stability to the vehicles, whereby the comfort of passengers is very much increased, the friction caused by the flanges of the wheels being thrown against the rails diminished, and the liability to derailment, or the escape of the wheels from the rails, reduced. On the other hand, when curves of small radius have to be used, the narrow gauge would be productive of less friction in passing round them. As regards the other advantages and disadvantages said to appertain to the narrow and the broad gauges, by their respective advocates, it has been proved that they have very little force.

3. If I were called upon to initiate a system of Railways in a new country susceptible of long straight lines and curves of large radius, I shall adopt the Indian gauge. In a country like Ceylon, where it is necessary to adopt extremely sharp curves, I should prefer the narrow English gauge.

BOMBAY.

No. 128, dated 21st July, 1864.

*Extract from a letter from—J. BROUGHTON, Esq., General Manager,
To—Secretary, G. I. P. Railway Company.*

I have the honour to inform you that for many years past, I have been in a position to judge of the merits of the different gauges, so far as regards the working, and the cost of working, of the following gauges, viz. :—

			Feet.	Inches.
The English broad gauge of	...	...	7	0
The English narrow gauge of	...	...	4	8½
And the Irish gauge of	...	...	5	3

The "Battle of the Gauges" has, in England, been fought over and over again, and there is no doubt about it in my mind that the majority of practical Railway men have hitherto agreed that the broad or 7 feet gauge is a mistake.

That the 7 feet gauge enables a company to run their passenger trains at a greater speed with less risk of accident, than can be run on a narrow gauge line, will, I think, be generally admitted by all Railway men, but that advantage (and especially if an advantage at all in such a country as Australia) is, I consider, more than counterbalanced by the large additional capital outlay requisite in the taking of the building of culverts and bridges, the heavier class of rail required to be laid down, the increased cost and maintenance of the rolling-stock, and the general unwieldiness of the stock at stations; the latter rendering it necessary to keep a larger staff of men employed for the shunting of waggons and carriages in the ordinary every-day working, or compelling the use of additional shunting horses, or the very expensive use of shunting engines at stations.

In making these remarks I have of course not forgotten the extra carrying capacity of the broad gauge vehicles over the narrow, but such extra carrying capacity is, I consider, fully counterbalanced by the decrease in number of vehicles conveyed in any one train on a broad gauge Railway.

It may be supposed that the broad gauge engines are constructed to enable them to move the same number of vehicles (under circumstances of gradients, &c.) as a narrow gauge engine on a narrow gauge line moves, but practice such I have found not to be the fact.

Thus, taking the Great Western of England Railway from my observation and recollection, I should say the average number of vehicles by a passenger train does not exceed 10; the maximum number being from 15 to 18, whereas on the Lancashire and Yorkshire Railway (a narrow gauge line) the average number of vehicles by a passenger train on the main line may be taken at from 16 to 18, the maximum number being from 25 to 28. Again, take the two lines in comparison with regard to trains of loaded waggons. The Great Western average load may be taken at 25 waggons, the maximum load being 35, whereas on the Lancashire and Yorkshire line the average ordinary gradients may be taken at about 35 waggons, and the maximum load at not less than 40 waggons. In both instances I of course speak from memory, but also from personal observation of both Railways for many years past.

A general consideration of the respective merits of the broad and narrow gauge system of Railways has brought me to the conclusion that the narrow gauge is preferable to the broad gauge, looking at a Railway in a comparative point of view.

The merits of the Irish narrow gauge system of Railways, viz., a 5 feet 3 inches gauge, should not be lost sight of, and years ago a special Commission of eminent men came to the conclusion that that gauge was the most economical. It entails little or no additional outlay in construction either in the extent of land required, or of roadways, and it does not entail any heavier rate of maintenance than an 18 inches narrow gauge road;—it does not entail in the running of a 5 feet 3 inches passenger train than in one of the lesser gauge. It to some extent enables what many Locomotive Engineers think a great advantage, viz., the better adoption of engines with outside cylinders, to all classes of vehicles of about one-fourth. It also gives an increased carrying capacity to all expenses, either in the movement of the train or in adding a corresponding increase in the working expenses, either in the movement of the train or in adding a corresponding increase in the working expenses, either in the movement of the train or in adding a corresponding increase in the working expenses.

I have here attempted to give a fair view of the work necessary to be done at the stations. ways over the broad, and from my reasons in favour of the narrow gauge system of Railways to the 7 feet gauge, but again I prefer the 4 feet 8½ inches gauge to the 5 feet 3 inches gauge.

I believe that the eminent (deceased) 3 inches gauge to either of the others. considered the father of the broad gauge, English Engineer Brunel, may fairly have been the belief in the utility of the broad gauge of Railways; but I also believe that when he died, the broad gauge system will never be extended, the narrow gauge died with him, and that the Western of England had begun to be built in England; and so far back as 1853-9, the Great and I think with that Company, it is very extensively the narrow gauge, or third rail, narrow gauge one, as the broad gauge, question of time the line becoming an entirely

I hope that these few remarks will be of service to the Government. It is in the general enquiry now being instituted by the Government.

Extract from a letter from—
J. E. TEST, Esq., Acting Chief Resident Engineer,
To—Secretary, G. I. P. Railway Company.

I have the honour to state that for lines of Railway is not a matter of comparative advantages of broad and narrow gauges as engaged much of my attention.

I am decidedly of opinion that a gauge wider than 5 feet 6 inches is merely a source of increased expense, especially in the construction of the line, without any really compensating advantage. I shall, therefore, confine my observations to the comparative advantages of the 4 feet 8½ inches and 5 feet 6 inches gauges.

The Great Indian Peninsula Railway is a double line of 5 feet 6 inches gauge, with a width of 30 feet between the lines. Comparing this with some of the older 4 feet 8½ inches gauge lines, it does not appear that either our earth-work or bridges are heavier, as a general rule, than those of the 4 feet 8½ inches gauge. The cost of the construction of the line has therefore been very slightly affected by the adoption of the wider gauge.

Rolling-stock for the wider gauge must necessarily be of heavier construction, the weight, and therefore cost, increasing in a higher rate than the increased capacity of carriage; and this appears to be the chief objection to the wider gauge. On the other hand, it has been almost admitted by the advocates of the narrow gauge, that a few extra inches in width would be of great convenience in the construction of power engines, although they can manage to construct them without it.

The wider gauge admits of steadier running, and the level of the permanent way is less felt in the narrower.

On the whole, I am of opinion, that the 5 feet 6 inches gauge was judiciously selected by the East India Company as the gauge for India, although Railways might have been constructed and stocked more cheaply if of the narrower gauge. This advantage of the 5 feet 6 inches gauge on the score of expense, however, would probably not have lasted for many years if the line had to carry a very heavy traffic.

No. 415, dated 9th July, 1864.

Extract from a letter from—S. GLOVER, Esq., Acting Locomotive Superintendent,
To—Secretary, G. I. P. Railway Company.

I have not had any experience on the broad gauge system, and am not able therefore to speak from my own knowledge of the relative merits of each. I may say that I prefer the 5 feet 6 inches Indian gauge to the 4 feet 8½ inches narrow gauge. The machinery of the engine is not so confined, and better to get at, and the rolling-stock runs much steadier.

No. 582.

Extract from a letter from—J. B. LANE, Esq., Managing Agent, B. B. and C. I. Railway,
To—Secretary to Government of Bombay, Railway Department.

I am myself of opinion that whatever the gauge may be, it is of the first importance that in every Province and part of the same country it should be uniform.

2. As to the width to be chosen, the circumstances of each country must (within certain limits) be considered in coming to a decision.

3. The broad gauge of the English Great Western is now, I believe, generally admitted to be too broad for any country, whilst the narrow gauge will also find many disapprovers, and the adoption of the three feet tram-road, where a railroad at all is required, is condemned by every practical man of experience as a mistake.

4. The gauge (5 feet 6 inches) determined upon for India, has so far proved itself suitable to every requirement. It admits of well-proportioned, useful, and powerful locomotives, as well as commodious waggons and carriages capable of running safely at high speed with a dead weight of ten or more tons.

5. I think the Indian gauge is wide enough; there may be a question whether the Irish gauge of 5 feet 3 inches may not be wide enough. It certainly has answered very well there. The Irish lines have been worked with very few accidents. The Great South and Western Railway of Ireland is not inferior to any line I know in stability of both wayworks, and stock. It has now been open throughout some 14 years, and the northern portion of it even longer, whilst its maintenance is, and always has been, low, and its dividends good.

6. I should myself be in favour of a 5 feet 2 inches or 5 feet 3 inches gauge for a new country such as Australia.

No. 1003, dated 11th August, 1864.

Extract from a letter from—F. MAHEW, Esq., Chief Resident Engineer,
To—Managing Agent, B. B. and C. I. Railway.

I have the honour to report that for a general trunk line of Railway, the working capabilities of which might be the only limits to its traffic, I would advocate the adoption of the broad gauge as affording more room for future improvement, as admitting of higher speed and of

the use of larger and stronger and more sal-
merely wanted for such a trunk line, but for
Railways, on all of which the wider gauge was
stock, I am of opinion that, for a general system
is, on the whole, a safe gauge for adoption.

2. The Indian gauge has been found to be
vehicles, and for the machinery of locomotives
economically maintained.

3. An inch or two in width of gauge, the
Indian 5' 6" is a good gauge, the Irish 5' 3"
arrangement in each case is that the gauge is

4. The experience in England should be
However extensive a country may be, or how
cations, I am of opinion that one gauge only
a system of Railways may become too vast
disadvantage of a break of gauge would be
derived in any one case from a small altera-
provinces of the same country.

No. 2117 A, dated 23rd July, 1864.

From—G. N. ANDERSON, Esq., Locomotive and Carriage Supt.,
To—Managing Agent, B. B. & C. I. Railway Company.

I have the honour to inform you that my
extends over a period of 15 years, and that
the broad, medium, and narrow gauge Railways

To decide upon the width of gauge in
thing to be considered is the description of
of traffic we may expect will have to be carried
15 or 20 years hence.

Should this anticipated traffic not exceed
narrow gauge English lines, for instance the
the narrow gauge line would be the most pre-
width of gauge on that and other narrow gauge
vey all the traffic brought to the line, they
of their engines from year to year, so as to take
in doing so there is but little scope for adding to
ty,* and that there is a greater amount of danger
than on the broader gauges; hence the objection
But suppose the daily traffic of a line will not
a maximum of 20 or 25 miles an hour, these ob-
would not exist. Every facility on the narrow
proportioned engine to run at a speed of 25
I do not consider that it pays to take long
traffic with but few stoppages.

The cost of constructing the narrow gauge
stock, the maintenance of permanent way, and
as regards working traffic, cheaper. I base my
for almost any description of goods, (unpressed
being the exception) a narrow-gauge waggon
without being stacked too high. What I mean
medium gauge waggons are constructed to
so much narrower than the other, they are con-
as the waggon weighs less, it will carry more
being of the same strength, the difference be-
gauge waggons of equal length is about one ton

Fewer porters are required to load and
them to and fro.

No doubt locomotive engineering may
gauge may be considered much too narrow.
undergo such a revolution that even the 7 feet
have, I think, got to the maximum length

* The system of working the boilers to a very high pres-
able, unless the water is very good.
sure, is now being resorted to, but this I think objection-

a train ought to be, but it is very possible we
tyres, and bearings, &c., may bring about this re-
is a large stock of each particular article to forward
to stow the whole of it in as few waggons as pos-
gauge we have on an average seldom more than
empties), should traffic be more in one direction
is this, that as far as our present locomotive prac-
the requirements, provided the traffic does not in-
high speed, which has not as yet paid. Rather
a reasonable speed.

No. 1888, dated 1864.

Extract from a letter from—T. G. NEWHA
To—Agent, Sind Railway Company, Kurrach

PARA. 2.—It is universally allowed that the
gearing and cylinders of goods engines with-
gives room enough with nothing to spare; so
6 inches gauge seems very suitable, and it is
of merchandize, but when the bulk of the traffic
unpressed, and in sufficiently large quantities, a

The width of the trucks will regulate that
fixing the width of the trucks to consider the
carriages are of such width as to accommodate
should be sufficient to seat another passenger, an

An engine built for the 7 feet gauge need
for the 5 feet 6 inches; but if the traffic re-
engines could be used on the 7 feet gauge, which
of the narrow gauges where the goods traffic is

No. 488, dated 1864.

Extract from a letter from—J. BROWN, Esq., Acting Locomotive Supt., Sind Railway.

With reference to your endorsement No. 17
inform you that, of the three gauges of Railways
7 feet in my opinion the 5 feet 6 inches is the most suitable.

An engine for a 4 feet 8½ inches gauge
box, and, if run at a high speed, will tend to oscillate.

An engine for the 5' 6" gauge, I think, will
arranged for the working parts of the engine.

The 7 feet gauge would require a much heavier
the cost of keeping up the repairs and maintaining
the permanent way be much higher.

BENGAL

No. 624, dated 24th July, 1864.

Extract from a letter from—D. W. CAMPBELL, Esq., Locomotive Superintendent,
To—Agent, East Indian Railway Company.

I beg to inform you that after the experience I have had on Railways in England
and in India, not only of the working, but of the construction of the rolling-stock,
I am quite of opinion that the 5 feet 6 inch gauge laid down by rule of the late Hon'ble
East India Company as the fixed gauge for guaranteed Railways in India, is decidedly the
best.

In England the 4 feet 8½ inches gauge was fixed it was more by rule of thumb than arrived at merely by following up what before Indian Railways were commenced of the working of English and other European lines.

With regard to the locomotive stock is found in designing it so as to arrange them together into an unhandy space. Tension, again, in increasing the power, it can only be done by interfering with and altering the machine. Now, with the 5 feet 6 inches gauge or space being ample for all requisite or space being ample for all requisite at a safe speed, and much more powerful engines can be made suited to run with safety at a higher speed than what can be designed and placed on the narrow or 4 feet 8½ inches gauge.

With reference to the carriage and wagon stock, the 5 feet 6 inches gauge is of equal advantage in handiness of construction, as the additional 9½ inches of width gives the builder space enough to make a much better class of vehicle, and to that may be added the fact that the carrying power is increased considerably without the weight being much interfered with.

In advocating the advantages of a 5 feet 6 inches gauge over a 4 feet 6 inches gauge, the question might be asked, why not go to 7 feet 6 inches at once like what Mr. Brunel introduced on the Great Western Railway in England? To that I would simply say, that in fixing such a wide gauge, Mr. Brunel went quite far, an unnecessary, an extravagant, and uncalled for extreme, quite as much so as the Indian Light Railway Company have gone the other way in laying down the 4 feet narrow gauge line between Nulhattee and Moorshedabad.

No. 3789, dated 5th August, 1864.

Extract from a letter from—The Chief Engineer,

To—Agent, East Indian Railway Company.

I cannot reply to your enquiry respecting the relative advantages of broad and narrow gauge Railways in terms more expressive than those which I heard used by the late Mr. Rendel when giving evidence in opposition to the Great Western, or broad gauge line, before a Committee of the House of Commons on the Brentford line. His words were as follows:—

"It must be admitted that in respect of speed, safety, and economy of traction, the Great Western or broad gauge line is unrivalled."

But great as the advantages of a broad gauge may be, uniformity of gauge is still more important, and although it can, I think, be shown that a broad gauge line can be constructed as cheaply as the ordinary narrow gauge sleeper line, and worked far more economically, nevertheless, if any great length of narrow gauge Railway has been constructed in Australia, it would not be prudent to alter the gauge. The evils of a break of gauge are so great, that the strongest advocates of the broad gauge in England are forced to admit the necessity for its removal, and ere many years the broad gauge will have ceased to exist.

No. 414, dated 14th July, 1864.

Extract from a letter from—A. W.

To—Agent, Eastern Bengal Railway, MURDOCH, Esq., Chief Resident Engineer,

In comparing the broad 7 feet gauge, and narrow (4 feet 8½ inches) gauge, the advantages accruing to the former appear to be—

- 1st.—It enables the engines to be built of greater power with inside cylinders, and at the same time gives ample room for the working parts, and which, owing to their not being cramped for room, are the more easily got at for repairs.
- 2nd.—That through the facility the engine is less subjected to oscillation than is the case with outside cylinder engines, thus causing fewer concussions, and consequent less wear and tear to the rolling-stock, of maintenance to a minimum, permanent way and works, reducing the cost of trains running more safely, and, in addition, to their being the cause of the possibility of using more powerful engines, and the attainment of a high rate of speed with greater security, especially in passing round curves.
- 3rd.—The increased width of base allows the attainment of a high rate of speed with greater security, especially in passing round curves.

The disadvantages shown by the broad gauge are—

- 1st.—Increased cost of construction owing to the greater base requiring wider banks to be taken up), wider bridges and works, and heavier permanent way.
 - 2nd.—Greater expense in construction of rolling-stock.
- In comparing the Indian 5 feet 6 inches gauge with the English broad and narrow gauges, the former appears to me to possess the following advantages:—
- It allows the application of inside cylinders as in the broad gauge.
 - It gives greater base, and, therefore, greater steadiness than in the narrow gauge.
 - It requires but very little more land than narrow gauge; the permanent way is not required to be heavier, so that the cost of construction will be about the same as is required for the narrow gauge.

In conclusion, I think that the Indian gauge avoids the defects of the broad gauge, whilst it adopts most of the advantages belonging to the narrow gauge.

No. 463, dated

Extract from a letter from—H. CARR

To—Agent, Eastern Bengal Railway.

As far as my experience of the Indian or narrow gauge, is cramped and difficult of access, it gives more room for the arrangement of the gear of an engine, which, in the narrow gauge, is cramped and difficult of access.

If engines are built suitable to the gauge of the Indian gauge, can be constructed so as to bear as good as one for a narrow gauge, so that the cost for a proportion of weight to the permanent way is more than for the narrow gauge. Increased upholding the permanent way need not be less steadiness is also obtained by the 5 feet 6 inches gauge.

I would not, however, be in favour of a wider gauge than the 5 feet 6 inches, with the present construction of permanent way.

The narrow gauge was, in the first instance, adopted in the north of England, from the old tramways made of wood, and was carried out for Railways, on the adoption of the locomotive, for the purpose of facilitating the working of lines running into each other. There is, however, nothing in the 4 feet 8½ inches gauge to recommend it over the advantages of the Indian gauge; and I therefore give it as my opinion that the Indian gauge is most suitable for Railways as at present made.

No. 196, dated

Extract from a letter from—A. S.

To—Agent, C. & S. E. Railway Company.

I have given the subject my careful attention, and beg to report upon it as follows:—The narrow or 4 feet 8½ inches gauge is used for all railways in England, with, I believe, only one exception. I consider one of its principal disadvantages applies to locomotives, for, if these are made with inside cylinders, so little room is left between them, that the working gear is very difficult of access for examination or repair, while, if they are made with outside cylinders, their overhanging weight materially lessens the steadiness when running at a high speed.

A line with this gauge has, however, the advantage of cheapness of construction in cases where it passes through valuable property, and is generally the case in England. It is tolerably well-known that George Stephenson, who introduced the narrow gauge, in his after experience found that a broader one would have answered better, that he was too late in arriving at this conviction to carry it into effect in England. On the other hand, Brunel, by constructing a line remarkable for its magnitude adopting a 7 feet gauge for the Great Western, view, viz., very high speed, but in other respects it has been far from a successful undertaking.

Between these two extreme gauges, I have one of 5 feet 6 inches in general use in India, and I can unhesitatingly express my most favourable opinion of it. So well adapted do I consider it to be for either this country or Australia, where, with the greater part of the land at the disposal of Government, and in a country offering few engineering difficulties of importance, the cost of construction of a line is comparatively trifling, bearing in view the enormous advantage it possesses in giving ample scope for the construction of engines of better proportions, roomy and airy carriages suitable to the climate, and waggons of greater carrying capacity; in addition to which a speed sufficiently high for all practical purposes can be obtained with perfect safety on a line with a 5 feet 6 inches gauge.

NORTH WESTERN PROVINCES.

No. 1290, dated 16th August, 1864.

From—G. SIBLEY, Esq., Chief Engineer,
and ay Company, N. W. Provinces.
To—Deputy Agent, E. I. Railway.

I am of opinion that the gauge of the Indian Railway presents, on a balance of advantages and disadvantages, a marked superiority over the English narrow gauge, the steadiness of travel which is not surpassed by any of the older lines at home excepting, perhaps, the Great Western, is doubtless most largely due to its greater base, to the lowness of angle between the extremity of the base and the centre of gravity. The additional first cost due to extra 91 inches of gauge is infinitesimally small; between 80 and 90 per cent. of the whole expenditure is affected on the full ratio of the increased width of gauges. All stations, all permanent way, excepting cross sleepers, all large bridges, are wholly unaffected, the only remaining item affected being cross sleepers, ballast, earthwork (central portion only, slopes remaining the same), and masonry of small bridges;—they are affected in ratio varying from 1 in 12 to 1 in 40 or 60.

As regards the weight of our waggons, if six inches were added to the gauge, the weight of heavier wood than is used at home; if another case in the same ratio as the carrying capacity would not, assuming the same overhung, increase a favourable compromise as could be obtained at the Engineers interested were committed to the work were to be begun anew it would be decided to add another 6 inches.

30th August, 1864.

No. 4127, dated 30th August, 1864.
From—P. D. NICOLL, Esq., Locomotive Superintendent,
Calcutta.
To—Agent, E. I. Railway Company.

I would give as my opinion that the 5 feet 6 inches gauge of our Indian lines is on the whole by far the best, as compared with any other that I know of. By its adoption there is ample room for the convenient arrangement of the machinery for a powerful locomotive, a great desideratum, the want of which is so felt in the narrow gauge, and the stock runs much smoother at high speeds than on the narrow gauge.

11th July, 1864.

No. 3278, dated 11th July, 1864.
From—C. CLEWORTH, Esq., Locomotive Superintendent,
Railway, N. W. Provinces.
To—Deputy Agent, E. I. Railway.

I think there can be no doubt that the Indian gauge of 5 feet 6 inches is far preferable to the English 4 feet 8½ inches as rolling-stock will run much steadier on the former, and the liability to get off the road will be considerably less.

I consider the 5 feet 6 inches to be about the best gauge that has ever been adopted, and preferable to either the Great Western, 7 feet 6 inches, or the Spanish 6 feet, as I think both those gauges unnecessarily wide, and the English 4 feet 8½ inches too narrow to be safe for anything like high speed, unless the road is kept in perfect order.

PUNJAB.

No. 262, dated 21st August, 1864.

From—Chief Engineer,
To—Agent, Punjab Railway Company.

With reference to your Memorandum No. 720 of the 12th instant, with enclosures, relative to the advantages and disadvantages of the Indian gauge, the former has the advantage of allowing space for the working machinery of the locomotive and for the production of steam, which do not overhang the rail to such an extent as the narrow gauge, and therefore not subject to the same oscillation. The disadvantages are increased cost of works and rolling-stock.

2. On the whole, I consider the Indian gauge as I have been able to ascertain, being the same as the narrow gauge.

Dated 4th August, 1864.

From—Locomotive Superintendent,
To—Agent, Punjab Railway Company.

In reply to your Memorandum No. 720 of the 12th instant, requesting information on the relative advantages of broad and narrow gauges, I beg to state that I consider the broad (i. e., Indian 5 feet 6 inches) gauge to be decidedly the better, though its increased cost of works and rolling-stock are disadvantageous.

2. Its advantages are, more room for heavy engines and motive machinery and boiler space (a very great advantage when heavy engines are used), roomier carriages, and a decreased amount of carriage and waggon stock. The broad gauge being able to travel at a higher rate of speed with less oscillation (the centre of gravity being comparatively lower in the broad than in the narrow gauge), consequently there is less wear and tear in rolling-stock, and less maintenance of way.

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3. This gauge offers other advantages in the construction of locomotives, the greater breadth of gauge allowing of a broader fire-box, and in cases of inside cylinder engines allowing greater width between the cranks; the boilers can be kept lower than on the narrow gauge, thus giving the double advantage of a lower centre of gravity, and at the same time a broader base.

4. No one who has travelled on inside cylinder narrow gauge engines at high speeds, and on a similar class of engine on the Indian gauge can fail to observe the difference between their relative steadiness, and there can be no doubt but that the wear and tear both to permanent way and locomotives must be very considerable, in consequence of this oscillation on the narrow gauge, which is almost entirely done away with by the well proportioned engines and stock which the Indian gauge admits of.

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*Extract from a letter from—W. G. SMART, Esq., Chief Engineer,
To—Agent and Manager, Madras Railway Company.*

PARA. 2.—In calling for the opinion of Railway officers on this subject, the Government does not, I imagine, contemplate the revival of the discussions known as the Battle of the Gauges which took place some 18 or 20 years ago, as they have access, no doubt, to Parliamentary evidence and other publications giving full and accurate information on all points connected with the question. The intention, I presume, is merely to obtain an expression of opinion based on observation of the merits of the Indian gauge. The only merit it appears to me to possess over the 4' 8" gauge is that it imparts greater stability to the vehicles, whereby the comfort of passengers is very much increased, the friction caused by the flanges of the wheels being thrown against the rails diminished, and the liability to derailment, or the escape of the wheels from the rails, reduced. On the other hand, when curves of small radius have to be used, the narrow gauge would be productive of less friction in passing round them. As regards the other advantages and disadvantages said to appertain to the narrow and the broad gauges, by their respective advocates, it has been proved that they have very little force.

3. If I were called upon to initiate a system of Railways in a new country susceptible of long straight lines and curves of large radius, I shall adopt the Indian gauge. In a country like Ceylon, where it is necessary to adopt extremely sharp curves, I should prefer the narrow English gauge.

BOMBAY.

No. 128, dated 21st July, 1864.

*Extract from a letter from—J. BROUGHTON, Esq., General Manager,
To—Secretary, G. I. P. Railway Company.*

I have the honour to inform you that for many years past, I have been in a position to judge of the merits of the different gauges, so far as regards the working, and the cost of working, of the following gauges, viz. :—

				Feet.	Inches.
The English broad gauge of	...	...	...	7	0
The English narrow gauge of	...	...	...	4	8½
And the Irish gauge of	...	...	...	5	3

The "Battle of the Gauges" has, in England, been fought over and over again, and there is no doubt about it in my mind that the majority of practical Railway men have hitherto agreed that the broad or 7 feet gauge is a mistake.

That the 7 feet gauge enables a company to run their passenger trains at a greater speed with less risk of accident, than can be run on a narrow gauge line, will, I think, be generally admitted by all Railway men, but that advantage (and especially if an advantage at all in such a country as Australia) is, I consider, more than counterbalanced by the large additional capital outlay requisite in the taking of land, the building of culverts and bridges, the heavier class of rail required to be laid down, the increased cost and maintenance of the rolling-stock, and the general unwieldiness of the stock when at stations; the latter rendering it necessary to keep a larger staff of men employed for the moving about of waggons and carriages in the ordinary every-day working, or compelling the use of additional shunting horses, or the very expensive use of shunting engines at stations.

In making these remarks I have of course not forgotten the extra carrying capacity of the broad gauge vehicles over the narrow gauge, but such extra carrying capacity is, I consider, fully counterbalanced by the decreased number of vehicles conveyed in any one train on a broad gauge Railway.

It may be supposed that the broad gauge engines are constructed to enable them to move the same number of vehicles (under similar circumstances of gradients, &c.) as a narrow gauge engine on a narrow gauge line moves, but in practice such I have found not to be the fact.

Thus, taking the Great Western of England Railway from my observation and recollection, I should say the average number of vehicles by a passenger train does not exceed 10; the maximum number being from 15 to 18, whereas on the Lancashire and Yorkshire Railway (a narrow gauge line) the average vehicles by a passenger train on the main line may be taken at from 16 to 18, the maximum number being from 25 to 28. Again, take the two lines in comparison with regard to goods trains of loaded waggons. The Great Western average load may be taken at 25 waggons, the maximum load being 35, whereas on the Lancashire and Yorkshire line the average (on ordinary gradients) may be taken at about 35 waggons, and the maximum load at not less than 40 waggons. In both instances I of course speak from memory, but also from personal observation of both Railways for many years past.

A general consideration of the respective merits of the broad and narrow gauge system of Railways has brought me to the conclusion that the narrow gauge is preferable to the broad gauge, looking at a Railway in a commercial point of view.

The merits of the *Irish* narrow gauge system of Railways, viz., a 5 feet 3 inches gauge, should not be lost sight of, and years ago a Special Commission of eminent men came to the conclusion that that gauge was the most useful one. It entails little or no additional outlay in construction either in the extent of land required, or of roadways, and it does not entail a heavier class of rail being laid down than the 4 feet 8 inches narrow gauge road;—it does not entail any heavier rate of maintenance than the narrow gauge, and, as a rule, there is less oscillation in the running of a 5 feet 3 inches passenger train than in one of the lesser gauge. It to some extent enables what many Locomotive Superintendents think a great advantage, viz., the better adoption of engines with outside cylinders. It also gives an increased carrying capacity to all classes of vehicles of about *one-fourth*, without adding a corresponding increase in the working expenses, either in the movement of trains or in the work necessary to be done at the stations.

I have here attempted to give a few reasons in favour of the narrow gauge system of Railways over the broad, and from my general experience I prefer the 4 feet 8½ inches gauge to the 7 feet gauge, but again I prefer the 5 feet 3 inches gauge to either of the others.

I believe that the eminent (deceased) English Engineer Brunel, may fairly have been considered the father of the broad gauge system of Railways; but I also believe that when he died, the belief in the utility of the broad over the narrow gauge died with him, and that the broad gauge system will never be extended in England; and so far back as 1838-9, the Great Western of England had begun to lay down very extensively the narrow gauge, or third rail, and I think with *that Company*, it is only a question of time the line becoming an entirely narrow gauge one, as the *broad gauge* stock works out.

I hope that these few remarks may assist in the general enquiry now being instituted by the Government.

Dated 3rd August, 1864.

*Extract from a letter from—E. W. WEST, Esq., Acting Chief Resident Engineer,
To—Secretary, G. I. P. Railway Company.*

I have the honour to state that the comparative advantages of broad and narrow gauges for lines of Railway is not a matter which has engaged much of my attention.

I am decidedly of opinion that any gauge wider than 5 feet 6 inches is merely a source of increased expense, especially in rolling-stock, without any really compensating advantage. I shall, therefore, confine my observations to the comparative advantages of the 4 feet 8½ inches and 5 feet 6 inches gauges.

The Great Indian Peninsula Railway has a 30 feet width of formation for a double line of 5 feet 6 inches gauge, with a width of 6 feet between the lines. Comparing this with some of the older 4 feet 8½ inches gauge lines in England, it does not appear that either our earth-work or bridges are heavier, as a general rule. The cost of the construction of the line has therefore been very slightly affected by the adoption of the wider gauge.

Rolling-stock for the wider gauge must necessarily be of heavier construction, the weight, and therefore cost, increasing in a higher rate than the increased capacity of carriage; and this appears to be the chief objection to the wider gauge. On the other hand, it has been almost admitted by the advocates of the narrow gauge, that a few extra inches in width would be a great convenience in the construction of powerful engines, although they can manage to construct them without it.

The wider gauge admits of steadier running of trains, and any imperfection in the level of the permanent way is less felt in the proportion that the wider gauge exceeds the narrower.

On the whole, I am of opinion, that the 5 feet 6 inches gauge was judiciously selected by the East India Company as the gauge for Indian Railways, in preference to the 4 feet 8½ inches gauge, although Railways might have been constructed and stocked more cheaply if of the narrower gauge. This advantage of the 4 feet 8½ inches gauge on the score of expense, however, would probably not have lasted for many years if the line had to carry a very heavy traffic.

No. 415, dated 9th July, 1864.

*Extract from a letter from—S. GLOVER, Esq., Acting Locomotive Superintendent,
To—Secretary, G. I. P. Railway Company.*

I have not had any experience on the broad gauge system, and am not able therefore to speak from my own knowledge of the relative merits of each. I may say that I prefer the 5 feet 6 inches Indian gauge to the 4 feet 8½ inches narrow gauge. The machinery of the engine is not so confined, and better to get at, and the rolling-stock runs much steadier.

No. 2682.

*Extract from a letter from—J. B. LANE, Esq., Managing Agent, B. B. and C. I. Railway,
To—Secretary to Government of Bombay, Railway Department.*

I am myself of opinion that whatever the gauge may be, it is of the first importance that in every Province and part of the same country it should be uniform.

2. As to the width to be chosen, the circumstances of each country must (within certain limits) be considered in coming to a decision.

3. The broad gauge of the English Great Western is now, I believe, generally admitted to be too broad for any country, whilst the narrow gauge will also find many disapprovers, and the adoption of the three feet tram-road, where a railroad at all is required, is condemned by every practical man of experience as a mistake.

4. The gauge (5 feet 6 inches) determined upon for India, has so far proved itself suitable to every requirement. It admits of well-proportioned, useful, and powerful locomotives, as well as commodious waggons and carriages capable of running safely at high speed with a dead weight of ten or more tons.

5. I think the Indian gauge is wide enough; there may be a question whether the Irish gauge of 5 feet 3 inches may not be wide enough. It certainly has answered very well there. The Irish lines have been worked with very few accidents. The Great South and Western Railway of Ireland is not inferior to any line I know in stability of both wayworks, and stock. It has now been open throughout some 14 years, and the northern portion of it even longer, whilst its maintenance is, and always has been, low, and its dividends good.

6. I should myself be in favour of a 5 feet 2 inches or 5 feet 3 inches gauge for a new country such as Australia.

No. 1003, dated 6th August, 1864.

*Extract from a letter from—F. MATTHEW, Esq., Chief Resident Engineer,
To—Managing Agent, B. B. and C. I. Railway.*

I have the honour to report that for a great trunk line of Railway, the working capabilities of which might be the only limits to its traffic, I would advocate the adoption of the broad gauge as affording more room for future improvement, as admitting of higher speed and of

the use of larger and stronger and more safe vehicles; but considering that the gauge is not merely wanted for such a trunk line, but for also probably a much greater length of tributary Railways, on all of which the wider gauge would involve a greater outlay on works and rolling-stock, I am of opinion that, for a general system of railways, the Indian gauge, 5 feet 6 inches, is, on the whole, a safe gauge for adoption.

2. The Indian gauge has been found to afford sufficient width for passenger and goods vehicles, and for the machinery of locomotives suited for such a rate of travelling as can be economically maintained.

3. An inch or two in width of gauge, I do not look on as of material consequence; the Indian 5' 6" is a good gauge, the Irish 5' 3" is a good gauge, and the greatest merit of the arrangement in each case is that the gauge is uniform all over each country.

4. The experience in England should warn us against allowing different or mixed gauges. However extensive a country may be, or however great the physical obstacles to communication, I am of opinion that one gauge only should be allowed in any country; as even though a system of Railways may become too vast to be worked as one, yet even in that case the disadvantage of a break of gauge would more than counterbalance any advantage to be derived in any one case from a small alteration from a dimension previously adopted in other provinces of the same country.

No. 2117 A, dated 23rd July, 1864.

From—G. N. ANDERSON, Esq., *Locomotive and Carriage Supdt.*,

To—*Managing Agent, B. B. & C. I. Railway Company.*

I have the honour to inform you that my practical experience in locomotive engineering extends over a period of 15 years, and that time has been divided almost equally between the broad, medium, and narrow gauge Railways.

To decide upon the width of gauge in introducing the iron road into our colonies, one thing to be considered is the description of traffic, and another the quantity or amount of traffic we may expect will have to be carried over the line when in its full prosperity, say 15 or 20 years hence.

Should this anticipated traffic not exceed half that conveyed over some of our greatest narrow gauge English lines, for instance the London and North Western, then it is my opinion the narrow gauge line would be the most preferable of the three; the only objection to the width of gauge on that and other narrow gauge lines is this, that in order to be able to convey all the traffic brought to the line, they have been obliged to go on increasing the power of their engines from year to year, so as to take full loads at high speeds; and they find that in doing so there is but little scope for adding to the power of the engine consistently with stability,* and that there is a greater amount of danger attending a high speed on the narrow gauge than on the broader gauges; hence the objection in *England* to the present narrow gauge. But suppose the daily traffic of a line will admit of the speed of each train being reduced to a maximum of 20 or 25 miles an hour, these objections to the narrow gauge that I speak of, would not exist. Every facility on the narrow gauge is afforded us for turning out a properly proportioned engine to run at a speed of 25 miles an hour with a load of about 45 vehicles. I do not consider that it pays to take longer trains than this, unless it be with *through* traffic with but few stoppages.

The cost of constructing the narrow gauge line is so much less, and the cost of rolling-stock, the maintenance of permanent way, and the working of traffic is also very much less; as regards working traffic, cheaper. I base my argument on this, that of the three gauges for almost any description of goods, (unpressed cotton, wool, and a few other sorts of material being the exception) a narrow-gauge waggon has room enough in it to contain a full load without being stacked too high. What I mean by a load is what the present broad and medium gauge waggons are constructed to carry, but the narrow gauge waggons being so much narrower than the other, they are consequently so much lighter, so that by as much as the waggon weighs less, it will carry more paying weight. Wheels, bearings, and springs being of the same strength, the difference between the weight of the broad and narrow gauge waggons of equal length is about one ton.

Fewer porters are required to load and unload narrow gauge waggons, and to move them to and fro.

No doubt locomotive engineering may undergo such a revolution that even the 7 feet gauge may be considered much too narrow. We have, I think, got to the maximum length

* The system of working the boilers to a very high pressure, is now being resorted to, but this I think objectionable, unless the water is very good.

a train ought to be, but it is very possible we may not have attained the width; still rails, tyres, and bearings, &c., may bring about this revolution to some extent. On lines where there is a large stock of each particular article to forward daily, it would be a great object to be able to stow the whole of it in as few waggons as possible, but it happens that on any of the three gauges we have on an average seldom more than two-thirds of a load (this is excluding empties), should traffic be more in one direction than another, so that the conclusion I come to is this, that as far as our present locomotive practice has extended, the narrow gauge meets all the requirements, provided the traffic does not increase to such an extent that we must get up high speed, which has not as yet paid. Rather than high speed, let us have extra loads at a reasonable speed.

No. 1888 of 1864.

Extract from a letter from—T. G. NEWNHAM, Esq., *Engineer in charge of Open Line,*

To—*Agent, Sind Railway Company, Kurrachee.*

PARA. 2.—It is universally allowed that the 4 feet 8½ inches gauge is too narrow for the gearing and cylinders of goods engines within the wheels, whilst the 5 feet 6 inches gauge gives room enough with nothing to spare; so far then as the engine is concerned, the 5 feet 6 inches gauge seems very suitable, and it is equally suitable for trucks for various kinds of merchandize, but when the bulk of the traffic is in raw material, such as cotton and wool unpressed, and in sufficiently large quantities, a wider gauge might be used with advantage.

The width of the trucks will regulate that of the carriages, and it would be desirable in fixing the width of the trucks to consider the convenience of the passengers. The Indian carriages are of such width as to accommodate four passengers. Any increase of this width should be sufficient to seat another passenger, and the 7 feet gauge just allows of this.

An engine built for the 7 feet gauge need not necessarily be much heavier than if built for the 5 feet 6 inches; but if the traffic required it, much more powerful as well as heavier engines could be used on the 7 feet gauge, which appears to possess many advantages over either of the narrow gauges where the goods traffic is great and of a bulky nature.

No. 488, dated 16th July, 1864.

Extract from a letter from—J. BROWN, Esq., *Acting Locomotive Supdt., Sind Railway.*

With reference to your endorsement No. 1735 of the 9th instant, I have the honour to inform you that, of the three gauges of Railways, viz., 4 feet 8½ inches, 5 feet 6 inches, and 7 feet in my opinion the 5 feet 6 inches is the most suitable.

An engine for a 4 feet 8½ inches gauge rather confines the gearing, cylinders, and fire-box, and, if run at a high speed, will tend to oscillate.

An engine for the 5' 6" gauge, I think, will run steadier at a high speed, and is well arranged for the working parts of the engine.

The 7 feet gauge would require a much heavier engine than either of the above gauges, and the cost of keeping up the repairs and maintaining the permanent way be much higher.

BENGAL.

No. 624, dated 26th July, 1864.

Extract from a letter from—D. W. CAMPBELL, Esq., *Locomotive Superintendent,*

To—*Agent, East Indian Railway Company.*

I beg to inform you that after the experience I have had on Railways in England and in India, not only of the working, but also of the construction of the rolling-stock, I am quite of opinion that the 5 feet 6 inches gauge laid down by rule of the late Hon'ble East India Company as the fixed gauge for guaranteed Railways in India, is decidedly the best.

In England the 4 feet 8½ inches gauge certainly does very well, but at the time it was fixed it was more by rule of thumb than from any possible practical experience; it in fact was arrived at merely by following up what had been used by carts on tramways, whereas, before Indian Railways were commenced to be made, the Engineers had all the benefit of the working of English and other European lines.

With regard to the locomotive stock for the 4 feet 8½ inches gauge, great difficulty is found in designing it so as to arrange the different working parts without cramping them together into an unhandy space. Then, again, in increasing the power, it can only be done by interfering with and altering the angle of stability or safe running of the machine. Now, with the 5 feet 6 inches gauge no such evils are to be met with, the width or space being ample for all requisite or reasonable purposes, and much more powerful engines can be made suited to run with safety at a far higher speed than what can be designed and placed on the narrow or 4 feet 8½ inches gauge lines.

With reference to the carriage and waggon stock, the 5 feet 6 inches gauge is of equal advantage in handiness of construction, as the additional 9½ inches of width gives the builder space enough to make a much better class of vehicle, and to that may be added the fact that the carrying power is increased considerably without the weight being much interfered with.

In advocating the advantages of a 5 feet 6 inches gauge over a 4 feet 6 inches gauge, the question might be asked, why not go to 7 feet 6 inches at once like what Mr. Brunel introduced on the Great Western Railway in England? To that I would simply say, that in fixing such a wide gauge, Mr. Brunel went quite to an unnecessary, an extravagant, and uncalled for extreme, quite as much so as the Indian Light Railway Company have gone the other way in laying down the 4 feet narrow gauge line between Nulhattee and Moorshedabad.

No. 3789, dated 5th August, 1864.

*Extract from a letter from—The Chief Engineer,
To—Agent, East Indian Railway Company.*

I cannot reply to your enquiry respecting the relative advantages of broad and narrow gauge Railways in terms more expressive than those which I heard used by the late Mr. Rendel when giving evidence in opposition to the Great Western, or broad gauge line, before a Committee of the House of Commons on the Brentford line. His words were as follows:—

“It must be admitted that in respect of speed, safety, and economy of traction, the Great Western or broad gauge line is unrivalled.”

But great as the advantages of a broad gauge may be, uniformity of gauge is still more important, and although it can, I think, be shown that a broad gauge line can be constructed as cheaply as the ordinary narrow gauge sleeper line, and worked far more economically, nevertheless, if any great length of narrow gauge Railway has been constructed in Australia, it would not be prudent to alter the gauge. The evils of a break of gauge are so great, that the strongest advocates of the broad gauge in England are forced to admit the necessity for its removal, and ere many years the broad gauge will have ceased to exist.

No. 414, dated 14th July, 1864.

*Extract from a letter from—A. W. MURDOCH, Esq., Chief Resident Engineer,
To—Agent, Eastern Bengal Railway.*

In comparing the broad 7 feet gauge, and narrow (4 feet 8½ inches) gauge, the advantages accruing to the former appear to be—

1st.—It enables the engines to be built of greater power with inside cylinders, and at the same time gives ample room for the working parts, and which, owing to their not being cramped for room, are the more easily got at for repairs.

2nd.—That through the facility thus afforded for the adoption of inside cylinders, the engine is less subject to oscillation than is the case with outside cylinder engines, thus causing fewer concussions, and consequent less wear and tear to the rolling-stock, permanent way and works, reducing the cost of maintenance to a minimum, and, in addition, to their being the cause of trains running more safely, particularly at high speeds.

3rd.—The increased width of base and the possibility of using more powerful engines, allow the attainment of a high rate of speed with greater security, especially in passing round curves.

The disadvantages shown by the broad gauge system, when compared with the narrow, are—

1st.—Increased cost of construction owing to the greater base requiring wider banks (and consequently more land to be taken up), wider bridges and works, and heavier permanent way.

2nd.—Greater expense in construction of rolling-stock.

In comparing the Indian 5 feet 6 inches gauge with the English broad and narrow gauges, the former appears to me to possess the following advantages:—

It allows the application of inside cylinders leaving ample room for the working parts as in the broad gauge.

It gives greater base, and, therefore, greater steadiness than in the narrow gauge.

It requires but very little more land or wider structures than is required for the narrow gauge; the permanent way is not required to be heavier, so that the cost of construction will be about the same as is required for the narrow gauge.

In conclusion, I think that the Indian gauge avoids the defects of the broad gauge, whilst it adopts most of the advantages belonging to the narrow gauge.

No. 463, dated 6th July, 1864.

*Extract from a letter from—H. CARRICK, Esq., Locomotive Superintendent,
To—Agent, Eastern Bengal Railway.*

As far as my experience of the Indian or 5 feet 6 inches gauge goes, I have no hesitation in saying that I consider it much better suited for Railways than the English narrow gauge. It gives more room for the arrangement of the gear of an engine, which, in the narrow gauge, is cramped and difficult of access, without adding materially to their weight.

If engines are built suitable to the gauge they have to work, it will be found that an engine, if properly designed for the Indian gauge, can be constructed so as to bear as good a proportion of weight to the permanent way as one for a narrow gauge, so that the cost for upholding the permanent way need not be more than for the narrow gauge. Increased steadiness is also obtained by the 5 feet 6 inches gauge.

I would not, however, be in favour of a wider gauge than the 5 feet 6 inches, with the present construction of permanent way.

The narrow gauge was, in the first instance, adopted in the north of England, from the old tramways made of wood, and was carried out for Railways, on the adoption of the locomotive, for the purpose of facilitating the working of lines running into each other. There is, however, nothing in the 4 feet 8½ inches gauge to recommend it over the advantages of the Indian gauge; and I therefore give it as my opinion that the Indian gauge is most suitable for Railways as at present made.

No. 196, dated 5th July, 1864.

*Extract from a letter from—A. SHANKS, Esq., Resident Engineer,
To—Agent, C. & S. E. Railway Company.*

I have given the subject my careful attention, and beg to report upon it as follows:—The narrow or 4 feet 8½ inches gauge is used for all Railways in England, with, I believe, only one exception. I consider one of its principal disadvantages applies to locomotives, for, if these are made with inside cylinders, so little room is left between them, that the working gear is very difficult of access for examination or repair, while, if they are made with outside cylinders, their overhanging weight materially lessens their steadiness when running at a high speed.

A line with this gauge has, however, the advantage of cheapness of construction in cases where it passes through valuable property as is generally the case in England. It is tolerably well known that George Stephenson, who introduced the narrow gauge, in his after experience found that a broader one would have answered better, that he was too late in arriving at this conviction to carry it into effect in England. On the other hand, Brunel, by adopting a 7 feet gauge for the Great Western, constructed a line remarkable for its magnitude and well adapted to the primary object he had in view, viz., very high speed, but in other respects it has been far from a successful undertaking.

Between these two extreme gauges we have one of 5 feet 6 inches in general use in India, and I can unhesitatingly express my most favourable opinion of it. So well adapted do I consider it to be for either this country or Australia, where, with the greater part of the land at the disposal of Government, and in a country offering few engineering difficulties of importance, the cost of construction of a line in addition to that required for the narrow gauge is comparatively trifling, bearing in view the advantage it possesses in giving ample scope for the construction of engines of better proportions, roomy and airy carriages suitable to the climate, and waggons of greater carrying capacity; in addition to which a speed sufficiently high for all practical purposes can be obtained with perfect safety on a line with a 5 feet 6 inches gauge.

NORTH WESTERN PROVINCES.

No. 1290, dated 16th August, 1864.

*Extract from a letter from—G. SIBLEY, Esq., Chief Engineer,
To—Deputy Agent, E. I. Railway Company, N. W. Provinces.*

I am of opinion that the gauge of the Indian Railway presents, on a balance of advantages and disadvantages, a marked superiority over the English narrow gauge, the steadiness of travel which is not surpassed by any even of the older lines at home excepting, perhaps, the Great Western, is doubtless most largely due to its greater base, to the lowness of angle between the extremity of the base and the centre of gravity.

The additional first cost due to extra $9\frac{1}{2}$ inches of gauge is infinitesimally small; between 80 and 90 per cent. of the whole expenditure remaining unaffected, and of the remainder no part is affected on the full ratio of the increased width of gauges. All stations, all permanent way, excepting cross sleepers, all large bridges, are wholly unaffected, the only remaining item affected being cross sleepers, ballast, earth-work (central portion only, slopes remaining the same), and masonry of small bridges;—these are affected in ratio varying from 1 in 12 to 1 in 40 or 60.

As regards the weight of our waggons, I would point out that they are built of generally heavier wood than is used at home; if another six inches were added to the gauge, the weight would not, assuming the same overhung, increase in the same ratio as the carrying capacity.

The 5 feet 6 inches gauge was probably as favourable a compromise as could be obtained at the time, considering how completely some of the Engineers interested were committed to the 4 feet $8\frac{1}{2}$ inches gauge, but I think that if the work were to be begun anew it would be decidedly advantageous to add another 6 inches and make the gauge 6 feet.

No. 4127, dated 30th August, 1864.

*Extract from a letter from—P. D. NICOLL, Esq., Locomotive Superintendent,
To—Agent, E. I. Railway Company, Calcutta.*

I would give as my opinion that the 5 feet 6 inches gauge of our Indian lines is on the whole by far the best, as compared with any other that I know of.

By its adoption there is ample room for the convenient arrangement of the machinery for a powerful locomotive, a great desideratum, the want of which is so felt in the narrow gauge, and the stock runs much smoother at high speeds than on the narrow gauge.

No. 3278, dated 11th July, 1864.

*From—C. CLEWORTH, Esq., Offg. Locomotive Superintendent,
To—Deputy Agent, E. I. Railway, N. W. Provinces.*

I think there can be no doubt that the Indian gauge of 5 feet 6 inches is far preferable to the English 4 feet $8\frac{1}{2}$ inches as rolling-stock will run much steadier on the former, and the liability to get off the road will be considerably less.

I consider the 5 feet 6 inches to be about the best gauge that has ever been adopted, and preferable to either the Great Western, 7 feet, or the Spanish 6 feet, as I think both those gauges unnecessarily wide, and the English universal gauge 4 feet $8\frac{1}{2}$ inches too narrow to be safe for anything like high speed, unless the road is kept in perfect order.

PUNJAB.

No. 262, dated 20th July, 1864.

*From—Chief Engineer, Punjab Railway,
To—Agent, Punjab Railway Company.*

With reference to your Memorandum No. 719 of the 12th instant, with enclosures, relative to the advantages and disadvantages of the Indian gauge as compared with the English narrow gauge, the former has the advantage of allowing a greater space for the working machinery of the locomotive and for the production of steam, also a greater width of carriages or trucks which do not overhang the rail to such an extent as upon the narrow gauge, and therefore not subject to the same oscillation. The disadvantages are an increased cost of works and rolling-stock.

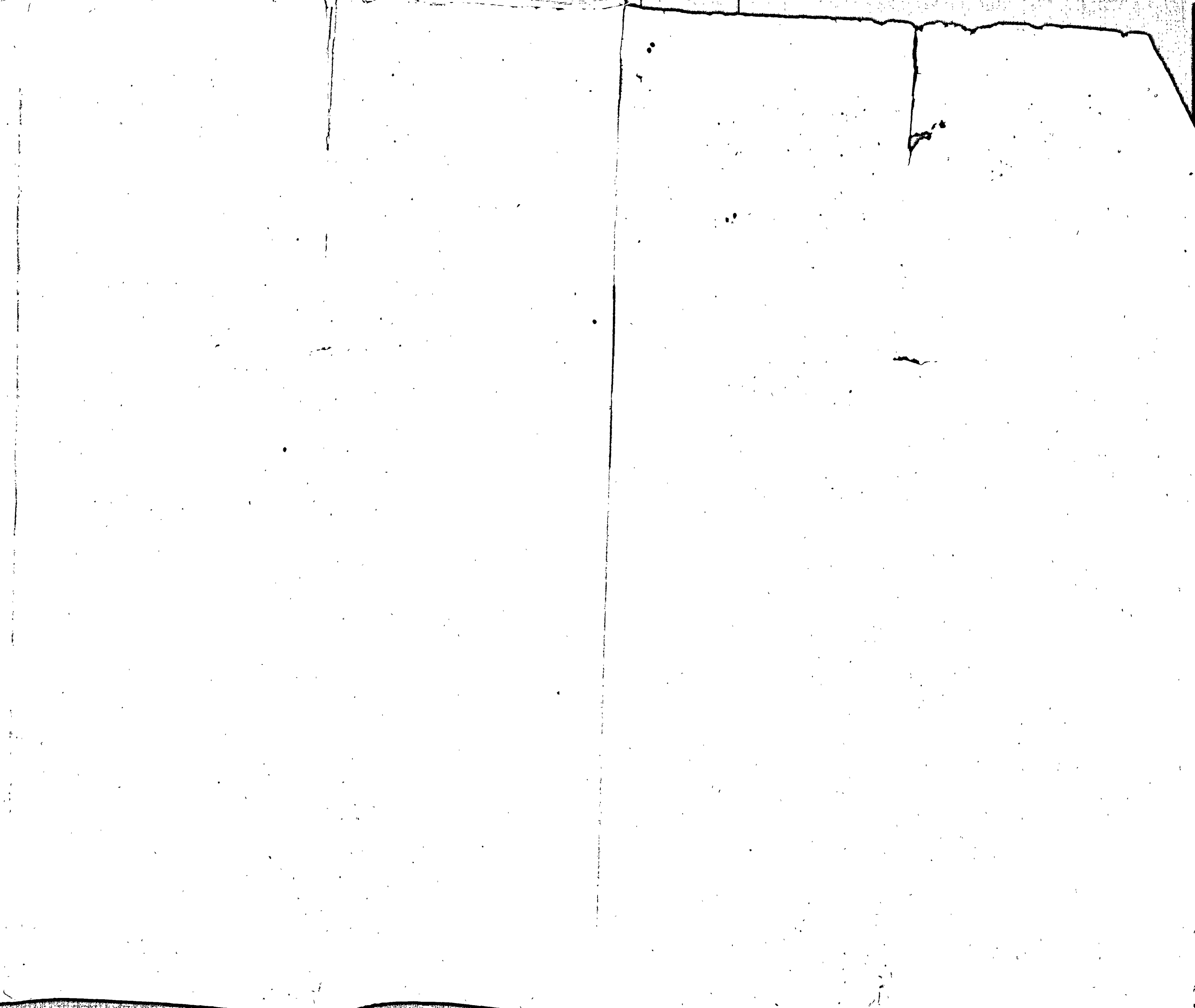
2. On the whole, I consider the Indian gauge preferable, the working expenses, so far as I have been able to ascertain, being the same as in the narrow gauge.

Dated 4th August, 1864.

*From—Locomotive Superintendent, Punjab Railway,
To—Agent, Punjab Railway Company.*

In reply to your Memorandum No. 720 of 12th July, requesting information on the relative advantages of broad and narrow gauges, I beg to state that I consider the broad (i. e., Indian 5 feet 6 inches) gauge to be decidedly the best, although its increased cost of works and rolling-stock are disadvantageous.

2. Its advantages are, more room for the locomotive machinery and boiler space (a very great advantage when heavy engines are repaired), roomier carriages, and a decreased amount of carriage and waggon stock. The fact of being able to travel at a higher rate of speed with less oscillation (the centre of gravity being comparatively lower in the broad than in the narrow gauge), consequently there must be less wear and tear in rolling-stock, and less maintenance of way.



EXTRACTS from Reports of the Head Officials
of the various Indian Railway Companies,
on the relative advantages of the Indian gauge
as compared with the English narrow gauge
for Railways.

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17-7-65. W. S. D. S.

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