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MADRAS RECORD OFFICE.

Government of Madras.

Public works **DEPARTMENT.**

G.O. No. 2903 — Press / Mis.

297-98.

Dated 15 11 1871.

Not to be folded or roughly handled

No. 297. Read the following letter from the Deputy-Secretary to the Government of India, (Railway,) to the Secretary to the Government of Madras, Public Works Department, (Railway,) dated Simla, 29th August 1871, No. 1,570-R. :—

I AM directed to acknowledge the receipt of your docket, No. 1,972, dated 27th July 1871), forwarding copy of Madras Government Proceedings (Railway No. 52 of 1871, which show that His Excellency the Governor in Council believes that no opinion regarding the future use of the Wurdah valley coal in Madras can be come to without further information as to the value of the fuel. The probability of the charges for freight between Cocanada and Madras being materially reduced, in event of the Wurdah valley coal being found to be of better quality as compared with English coal than has been hitherto supposed, is also discussed in these Proceedings.

2. In reply, I am directed to forward, for the information of the Madras Government, the papers mentioned in the margin, which will give all the information which is now in the possession of the Government of India as to the heating qualities of the Nerbudda valley and Wurdah valley coals, together with the results of the exploration for coal in the Godavery valley near Dumagudium.

From Chief Commissioner, Central Provinces, No. 188-2,193, dated 14th May 1870, and enclosures.
To do., No. 1,087-R., dated 18th June 1870.
From Bombay, No. 948, dated 5th July 1870, and enclosures.
From do., No. 1,089, dated 2nd August 1870, and enclosure.
To do., No. 1,434-R., dated 16th Augt. 1870.
From do., No. 1,242, dated 6th September 1870, and enclosures.
From Bengal, No. 922-G., dated 8th May 1871, and enclosure.
To do., No. 886-R., dated 22nd May 1871.
From Department of Agriculture, Revenue, and Commerce, to Public Works Department, No. 37, dated 11th August 1871, forwarding copy of Mr. Blanford's report on coal boring operations on the Godavery, and of the orders issued thereon.

3. Continued trials with Nerbudda valley and Wurdah valley coals tend to give confidence in the value of both as fuel for locomotive purposes. The experiments have shown that, by a judicious arrangement of the fire-bars, this inferior coal can be more completely consumed within the fire-box than was at first supposed possible; and there is every probability that the East Indian Railway and the Great Indian Peninsula Railway will receive from these sources of supply as much coal as they will together require on 1,000 miles of railway as soon as the collieries are fairly opened.

4. There is, however, no present reason to believe that ten tons of either Wurdah valley or Nerbudda valley coal are worth more for heating purposes than 6 or 7 tons of ordinary English coal, such as is usually laid down in Indian ports, and the Government of India concur in the opinion that so long as English coal can be delivered in Madras at Rupees 20 or Rupees 25 per ton, it is unlikely that the Wurdah valley coal can be economically used on the Madras Railways.

5. Mr. Blanford's and Mr. VanStavern's researches on the Lower Godavery show clearly that one small bed, containing 25,000 tons of coal and shale, may be profitably worked, and its close proximity to the river renders this small isolated bed the more valuable. Mr. Blanford is not sanguine as to the discovery of a permanent coal supply in British territory in this neighbourhood, but the investigation hitherto has been extremely partial, and many districts remain unexplored. The Governor-General in Council has directed that the more complete exploration suggested by Mr. Blanford shall be made, and His Excellency in Council is

not without hope that the further search may be successful, and that if the East Coast Canal were completed, Madras may be supplied with indigenous coal of good quality at moderate cost. Meanwhile, I am to suggest, for the consideration of the Government of Madras, the expediency of taking steps towards the preparation of a project for the completion of inland water-communication between the delta of the Godavery and Madras.

From the Officiating Secretary to the Chief Commissioner of the Central Provinces in the Public Works Department, Railway Branch, to the Secretary to the Government of India, Public Works Department, dated 14th May 1870, No. 188-2, 193.

I AM directed to forward papers as on the margin, which refer to trials made with Chanda coal in firing locomotives on the Great Indian Peninsula Railway, and also the portable and locomotive engines at the Kanhan bridge-works.

Letter No. 1, dated 11th October 1869, from Messrs. O'Callaghan and Binnie.
" " 2, " 21st " " from Mr. Binnie.
" " 189—1,303, dated 29th November 1869, from Executive Engineer, Kanhan Division.
Memorandum by Chief Engineer on above letters.

2. Some deep pit Googoose coal* has been lately sent to the Kanhan bridge-works for use in firing the engines, and a report upon this fuel will be submitted in due course.

* Chanda District.

Memorandum by the Officiating Chief Engineer, Department Public Works, Central Provinces, on reports received from Messrs. Binnie and O'Callaghan, Executive Engineers, upon No. 2 experiment lately made with Chanda Coal, used in firing No. 281 Locomotive, G. I. P. Railway.

AFTER perusal of the report dated the 11th October from Messrs. O'Callaghan and Binnie, I considered that some further information regarding the cost of the Chanda coal was advisable, the engineers having based their calculations of its price at Nagpoor only.

I therefore requested these gentlemen to institute further inquiry and to submit further data on this point, which is an all-important one; and I told Mr. Binnie what I considered he should endeavour to get at and prove, viz, the value of this Chanda coal at other stations of the G. I. P. Railway as compared with English hauled up from Bombay. I have the pleasure now to forward, in addition to the first interesting report, another which I shall call No. 2. It is lucid, and gives valuable and, I believe, fairly correct data and information regarding the points which required to be cleared up.

2. Turning to No. 1 Report, which describes the late and second experiment, the 2nd and 3rd paragraphs state that when engine No. 281 was first fired with Chanda coal the consumption was 88 lbs. per mile of run. It is now proved that at the 2nd trial 78·5 lbs. were consumed; this exhibits a saving of 9½ lbs. per mile, and was caused doubtless by the alteration made in the fire-bars. About one inch is the usual space between the bars for English coal; for the Chanda this distance was enlarged to 2 inches, with a view of increasing the draught, and of more readily clearing out and relieving the fire-bars of clinker and excess of ash, and which is due in excess to Chanda over the quantity existing of the same when English coal is used. This change in the arrangement of the fire-bars, though most necessary, is, I would remark, a very cheap and simple one to execute.

3. The general results given in the first report may be summarised as follows:—

No. 281 engine hauled a goods' train of 281 tons from Nagpoor to Budnaira, a distance of 107 miles, at an average speed of 16 miles per hour. The pressure in the boiler averaged at starting 111·5 lbs. per square-inch, at times rising to 115·0, and on arrival at a station 98 lbs. The lowest pressure during the run being 83 lbs. The exceptional fall to 76 need not be noted,—see remark on table annexed to the report.

The engine had steam up, and was fired by Chanda coal from 5 A.M. to 6¼ P.M.

	Minutes.	*H. M.*
or for 13¼ hours. The actual running time was	402÷60 =	6 42

Further, the train arrived at Budnaira, its terminal station, half an hour before the time fixed in the Company's tables, the engine having then a pressure of 110 lbs. in the boiler. It is worthy of remark also, that from Nagpoor to Budnaira the gradients are against an engine, and that the consumption of English coal of 37 lbs. per mile is the average of journeys both ways, while that for the Chanda is for the ascending journey only.

4. It is proved by this experiment (see report, paragraph 5) that 37 lbs. of English coal equal 78½ lbs. of Chanda, or that it requires a little more than double the quantity of Chanda to perform a duty equal to the returns obtained by firing with Home fuel. But the country coal obtainable was of the worst kind, being surface quarried, "taken from the bank of the Wurdah river, where it had lain for ages saturated with water, and had doubtless parted with most of its gases, and lost much of its hardness."

The specimen procurable consisted of very small lumps, and may be truly termed medium slack.

5. I quite agree with Messrs. O'Callaghan and Binnie's opinion, expressed at the end of their 6th paragraph, that when the Chanda coal is worked by shafts and mined at moderate depths, coal of a much superior quality to that used in the late experiment will certainly be procured; otherwise the Chanda field would differ from every other known.

6. The Executive Engineers make an important observation in the 7th paragraph of their report. They state that firing with what may be properly termed an inferior specimen of Chanda coal, the smoke-box of the engine did not require to be cleared of any deposit, which must be done when English patent fuel is used; that the clinker formed was not much in exess of that taken from many engines in Great Britain; and that the Chanda coal burned brighter and clearer when attended to carefully by the Stoker.

7. The 9th paragraph of the report led me to call on Messrs. O'Callagan and Binnie for the further information I have explained was necessary, and this has been forwarded in their letter No. 2 of the 21st October.

This document starts with the fair assumption and present calculation that two tons of Chanda are equal to one of English coal for locomotive purposes, and though we may safely expect to receive hereafter from the coal mines at Chanda a much superior coal, yet it is best to reason and calculate upon the specimen actually fired. Now the calculation being that two tons of Chanda coal equal one of English, it follows that we must show how the former can be delivered along the line at a cost equal to, or less than, one ton of the latter, firing properties and results from both coals being similar.

If two tons of Chanda coal cost more along the line than one of English it would not pay, of course, to fire with the former fuel.

It was necessary to go into this matter, and endeavour to show by fair and correct data where the Chanda coal will pay to use, where it will not, and where also the point or station of similarity in cost with English may be expected to be on the G. I. P. Railway.

8. I agree in the main with the data given by Mr. Binnie in his paragraphs 3 and 5.

This gentleman takes the working expenses of the railway at 50 per cent. of the receipts; the cost of carriage of coal to the Company at 5 Pies per ton per mile (and this, I think, is more than the actual cost); the cost of Chanda coal, at 5 Rupees per ton at the pit's mouth, and the cost of English coal (Welsh) at Bombay Rupees 30 per ton.

Mr. Binnie then starts with the data that two tons of Chanda coal are valued Rupees 10 at the pit's mouth, and one ton English is valued Rupees 30 at Bombay; and he has compiled a lucid and interesting tabular statement, which is explained by him in his 6th and 7th paragraphs.

For instance, the table shows that at Bhosawul, a station 271 miles from Chanda and 273 from Bombay, and where the main line from Jubbulpore and the Nagpoor branch join, two tons of Chanda coal could be delivered, at a rate of 5 Pies per ton per mile, at a cost of Rupees 12-15-11 less than one ton of English.

It follows therefore that the main line from Bhosawul to Jubbulpore and the branch to Nagpoor can be fed with Chanda coal considerably cheaper than with English.

Columns 1 and 2 of the table exhibit various rates of carriage; columns 3 and 4 show the distances of the point of common value from Chanda or Bombay respectively. To explain, I note that taking the rate of carriage at 3 Pies per mile, which is, however, too low for a practical

working price, Chanda coal would be as ch
at Bombay. Again, taking the fair rate of
would fall 438 miles from Chanda and 108
top of the Thull Ghaut. Therefore, at every s
in cheapness over English.

Columns 6 and 7 give the cost of two of
mon points of value.

9. In the 2nd portion of the table, co
tons of Chanda coal and one of English at Bho
rates are exhibited to meet inquiry, and becau
mile at which the Railway Company calcula

The last column, No. 3, proves the in
3 Pies to 10 Pies per ton per mile a saving

10. The Executive Engineer in the
statement, which is that, if a slight lowering
4·57 Pies per ton per mile, Egutpoor will be
the top of the Thull Ghaut where the largest cha
would accrue, as the Railway Company could
up the ghaut from Bombay.

11. I am quite confident that a superior
fore anticipate the time when this fuel will be

* See Executive Engineer's paragraph 8.

coal can be deposited at the Callian Junction
engines on the Poona branch, and onwards to
the Chanda coal mines.

12. Finally, Mr. Binnie points out in hi
be used with a large profit at any reasonable ra
of Bhosawul, and the Executive Engineer rema
instead of one English, a saving of no less t
present used.

13. I am informed, the Mining Enginee
can be mined and placed at the pit's mouth
Rupees 5 per ton will be reduced, and the
favourable.

14. It is well to explain, perhaps, that
Wurdah Station on the G. I. P. Railway being

15. In paragraph 2 of letter No. 2,673-
the Government of India, it is stated that t
that 88+85 cwts.÷2 = 86½ cwts., or 4 tons
man to equal 3 tons 7 cwts. of Raneegunge;
to fire the engines of the E. I. Railway was
"obtained at a greater depth. The major p
"its light nature it did not go as far as the

These remarks of the Locomotive Superi

*See my paragraph 4.

would be, I need hardly say, a result of the

To Messrs. Binnie and O'Callaghan my
studied this important subject, and for the
bring the same to the notice of the Chief C

reap as English, 62½ miles as it were out at sea
Pies per ton per mile, the common point of value
rom Bombay, or near Deolallee, 24 miles from the
tation N.-E. of Deolallee, Chanda coal will progress
y

handa and one of English coal at the various com-

ns 1 and 2 are given the respective prices of two
awul for various rates of carriage, and these various
se Mr. Binnie is not able to state the exact rate per
th[ey] can carry coal at for their own purposes.

ant fact that at any rate of carriage varying from
[must]be effected by using Chanda coal at Bhosawul.

aragraph of his report gives a most valuable,
f the cost of carriage is obtainable, or from 5 to
e common point of value. This is the station at
t engines are put on, and an important advantage
[dispense with the necessity of bringing English coal

class of Chanda coal will be obtained; I would there-
of such a class as that one and-a-half ton will equal
one of English.* If this result is gained, then,
at the rate of 5 Pies per ton per mile, Chanda
t a cost equal to English. This would enable the
Sholapore and Bellary, to be fired with fuel from

s 9th paragraph that even now Chanda coal can
te of carriage per ton per mile on all points N.-E.
rks that, even when expending two tons of Chanda
an £1-6-0 accrues on every ton of Home fuel at

r now at Chanda, Mr. M. Fryar, reports that coal
or Rupees 2 per ton. If so, Mr. Binnie's data of
calculation exhibited in the tables will be more

our reasoning is based on the supposition of the
connected with the Chanda coal fields by railway.
00 of the 3rd ultimo from the Chief Commissioner to
e Locomotive Superintendent E. I. Railway reports
½ cwts. of Chanda coal, were found by that gentle-
d the report goes on to state that what was supplied
not a fair specimen of the quality which "may be
tion had the appearance of surface coal, and from
dinary run of coal."

endent are correct.* We may, however, expect to
receive coal which will equal, or very nearly
approach, the value of Raneegunge, and this
ghest value and importance.

anks are due for the manner in which they have
very clear and interesting reports; and I beg to
missioner.

(S[igned]) T. W. ARMSTRONG, M.I.C.E.,
Offg. Chief Engineer, Central Provinces.

From F. L. O'CALLAGHAN AND A. R. BINNIE, Executive Engineers, to the Chief Engineer, Central Provinces, dated Nagpore, 11th October 1869, No. 1.

IN accordance with your request we have the honour to report as follows on the result of an experiment made on the G. I. P. Railway on the 8th instant, for the purpose of ascertaining the value of the coal from the Chanda field as fuel for the use of locomotive engines:—

2. We beg to remark that the experiment was entirely conducted by the officials of the Company; that it was the second trial made by them, and was undertaken more particularly to ascertain if, by increasing the distance between the fire-bars, a higher duty could not be obtained from the coal than in the first trial, when, although a goods' train was run through from Nagpore to Budnaira within the ordinary time, yet some delay occurred at the stations in cleaning the fire-grate of the engine, it being only adapted for burning English coal and patent fuel; the general result of the first trial being a consumption of about 88 lbs. of Chanda coal per mile run.

3. The engine No. 281, with which the experiments were made, was the same in both cases, and the load drawn on the second occasion consisted of two brake-vans, one first-class carriage, six loaded and twenty-four unloaded waggons of various sizes. The usual rule of the Company is to consider three empty waggons equal to two loaded ones; therefore we have the train composed as follows:—

6 Fully loaded waggons	=	6 loaded.
24 Empty waggons × ⅔	=	16 „
1 First-class carriage	=	1 „
1 Extra brake-van	=	1 „

or equal to a train composed of 24 loaded waggons and one brake-van, say, 270 tons, exclusive of engine, tender, coal, and water—an ordinary goods train on this part of the line consists of 25 loaded waggons and 1 brake-van, or, say, 281 tons.

4. The result of the trial of the 8th instant as regards speed and pressure of steam kept in the boiler is given in the Table annexed.

5. The quantity of coal consumed on this trip was 75 cwts., or 8,400 lbs., which gives a consumption of 78·5 lbs. per mile, including coal expended in getting the steam, shunting, and making up train in the Nagpore station-yard, and delays at stations not included in the time noted in the Table. The ordinary consumption of English coal in the same engine varies from 36 to 43 lbs. per mile, or an average of about 37 lbs., thus showing that the consumption of Chanda coal is a little more than double that of English, the same duty being performed in both cases.

6. The specimen of Chanda coal experimented with must not be accepted as of average quality, being only surface coal obtained from the bank of the Wurdah river, where it has been saturated for ages with water, and from its proximity to the surface must have parted with most of its gases and lost much of its hardness. From what we now know of this field it will differ from most others in the world, if, when worked by shafts of moderate depth, and sunk at points some little distance from the river, it does not yield coal of a much superior quality.

7. It will be observed that the effect of the slight alteration in the grate, *viz.*, increasing the distance between the bars from 1½ to only 2 inches, has been to reduce the consumption of coal from 88 to 78 lbs. per mile run, and at the same time, in a great measure, to remove the difficulty experienced in the first trial in keeping up a good draught of air and a grate free from ash and clinker. With the Chanda coal no necessity was found for clearing the smoke-box of any deposit, as we observe has to be done when English-made patent fuel is used; nor does the quantity of clinker formed appear much in excess of that taken from many engines in use in Great Britain; and it was noticed that the coal burned clear and bright with a little extra attention on the part of the Stoker.

8. We cannot but express our gratification at the result of this trial, for it has proved beyond doubt that it is quite possible to work the ordinary goods' traffic, with even coal of the quality of the specimen at our disposal, at the present or even a higher rate of speed, as may be judged by the fact that the train on the 8th instant arrived at Budnaira half an hour before the time usually allowed by the Company, and had still a pressure of steam in the boiler equal to 110 lbs. on the square inch.

9. The facts given above become of much importance when it is considered that the cost of English coal at Nagpore is about Rs. 60 per ton, and that Chanda coal of a far better quality than that experimented with can, by the aid of a rail or tramway, be delivered at a maximum cost of Rupees 15, which, with even this high rate per ton, would show a saving in the fuel bill of the Company of 50 per cent.

Mining 1 ton—	Rs.	A.	P.
Cost at pit's mouth...	5	0	0
Carrying 100 miles, at 10 Pies per mile, G. I. P. R. 1st-class goods' rate	5	3	0
Contingencies, say	4	12	0
Total...	15	0	0

10. There will, doubtless, be some opposition on the part of those of the Company's servants most affected to the introduction of Chanda coal, entailing, as it will, some little extra labour, as they have been hitherto accustomed to the luxury of the best English fuel; but there can be little doubt that, with slightly modified fire-boxes and careful stoking with the better class of Chanda coal reasonably to be expected when the field is opened up, the Company will find it to their advantage to use it rather than import fuel from Europe.

11. It is, perhaps, worth noting that in this distance the gradients on the whole are against an engine running from Nagpore to Budnaira, but it will be observed that the consumption of English coal in the engine No. 281 given above, at 37 lbs. per mile, is the average of what it consumes in working both ways.

In conclusion, we beg to thank the officers of the Company for their courtesy and attention during the experiment.

TABLE of Speed and Pressure of Steam.

Stations.	Time.	Miles.	Actual time taken between stations in minutes.	Speed in miles per hour.	Pressure at starting in lbs. per square inch.	Pressure on arrival in lbs. per square inch.	Lowest pressure during run.	Remarks.
Nagpore—Departure.	9-25	17	63	16·19	112	100	83	The fire was lighted at 5 A.M.
To Boree—Arrival ...	10-28							
Boree—Departure ...	10-45	12	35	20·57	110	110	105	Owing to experimental firing, which was found not to answer, the steam fell to 76 lbs., when a stoppage of 6 minutes was made, and the pressure then rose to 110 lbs. If this stoppage (the only one made between stations) be taken into account, the speed was 16·06 miles per hour.
To Sindee—Arrival ..	11-20							
Sindee—Departure ...	11-30	19	77	14·81	115	80	76	
To Wurdah—Arrival...	12-47							
Wurdah—Departure ..	1-50	19	80	14·33	115	102	85	
To Poolgaum—Arrival.	3-10							
Poolgaum—Departure.	3-34	23	94	14·68	100	80	80	
To Chandoor—Arrival.	5-08							
Chandoor—Departure.	5-22	17	53	19·25	115	110	90	
To Budnaira—Arrival.	6-15							
Totals and averages.	...	107	402	16	111·5	98	86·5	Totals and averages.

Total time spent on the experiment from 5 A.M., when the fire was lighted, until the arrival of the engine at Budnaira at 6-15 P.M., including all stoppages, &c., was 13 hours 15 minutes.

From the Officiating Executive Engineer, Nagpore Division, to the Chief Engineer, Central Provinces, dated Nagpore, 21st October 1869, No. 2.

As desired by you I have made every inquiry to ascertain the actual cost of carrying coal on the G. I. P. Railway, so as to enable me to form an estimate of the distance to which Chanda coal can with profit be carried on that line in the direction of Bombay, but up to the present time I am unable to obtain *exact* returns. Knowing, however, that you urgently required the information, I have drawn up the following comparative remarks on the cost of carrying it at different rates.

2. From our trial of the 8th instant we proved that, taking the inferior specimen of Chanda coal we had to experiment with, about two tons were required to do the work of one ton of English coal; and although there is every reason to suppose that we shall obtain a very much better quality when the field is opened up, yet I shall still assume that two tons of Chanda coal will be required so as to leave a large margin for contingencies.

3. The charge made by the G. I. P. Railway for carrying goods on their line is about 10 Pies per mile per ton. Under ordinary circumstances we know that the working expenses are about 50 per cent. of the receipts; the working expenses will therefore probably be about 5 Pies per mile per ton. Any reduction in this rate, as will be seen, is in favour of the Chanda coal.

4. The distance from Chanda to Wurdah *via* Wurrora and Hingunghat (which would probably be the line taken by a rail or tramway) if made, is 76 miles; Chanda to Bhosawul *via* Wurdah is 271 miles; and Chanda to Bombay *via* Wurdah and Bhosawul is 546 miles.

5. As two tons of Chanda coal are assumed to be requisite to perform the work of one ton of English coal, the rate per mile for carrying it may be said to be double that of carrying one ton of English coal. The cost of coal at the pit's mouth at Chanda, Mr. O'Callaghan and I assumed at Rupees 5 per ton. This is undoubtedly a safe sum, erring rather in being too high.

The price of English coal at Bombay cannot be safely taken at less than Rupees 30 per ton as an average.

6. The question may be dealt with in the following way:—Two tons of coal at Chanda cost Rupees 10; one ton of coal at Bombay cost Rupees 30; the carriage of one ton of coal per mile from Bombay is half the cost per mile of carrying 2 tons of coal from Chanda towards Bombay, the distance from Bombay to Chanda being 546 miles.

Assuming certain rates as seen in Table B., I have worked out the point between Bombay and Chanda, where the value of the coal becomes equal, at which point I have given its value; also the prices and differences of each coal at Bhosawul for the different rates.

7. On inspection of the Table it will at once be seen that, at any rate of carriage between 3 and 10 Pies per ton per mile, there will be a very considerable advantage in point of economy in using Chanda coal at Bhosawul Junction, which may be said to be half way from Chanda to Bombay. If, as is most probable, the coal can be carried for 5 Pies per ton per mile, then the point of common value falls between Nandore and Deolallee, at 108 miles from Bombay. A very slight improvement in the value of Chanda coal on the reduction of the rate per ton per mile to 4·57 Pies would cause the point of common value to fall at Egutpoora, the changing station at the top of the ghauts, 75 miles from Bombay. This, if effected, would be a most important advantage, as it would enable the G. I. P. Railway Company to dispense with the necessity of bringing coal from Bombay up the ghauts to work the traffic on the Nagpoor and Jubbulpore branches of their line eastward of Egutpoora.

8. Should the value of Chanda coal improve (as there is every reason to expect) to such an extent as to enable 1·56 tons of it to do the work of one ton of English coal, then, at a rate of 5 Pies per mile per ton, the point of common value would fall at Callian Junction, which would enable the south-eastern branch of the G. I. P. Railway (to Poonah and Madras) to be worked at an advantage with Chanda coal, and this would probably lead to the entire abandonment of English coal as fuel on the G. I. P. Railway.

9. At the present time we can, however, feel certain that Chanda coal can be used with a large profit at any reasonable rate per ton per mile for carriage on all points of the G. I. P. Railway eastward of Bhosawul Junction. And this profit is very large, indeed, when compared with what in England would be considered an advantage of one coal over another, where I have often seen the whole merits of two competing lines of railway argued before Committees of both Houses of Parliament, on the ground that one of them could deliver coal at 1*s.* 6*d.* to 2*s.* 6*d.* per ton cheaper than the other; whereas, in this case the advantage is not to be increased by shillings but by pounds, for, at a rate of carriage of 5 Pies per ton per mile (supposing under the most disadvantageous circumstances that two tons of Chanda are required to do the work of one of English coal) the saving would be just £1-6-0 on every ton of English coal at present used.

10. As soon as I can ascertain the actual cost of carriage on the G. I. P. Railway, I will again address you on this subject. In the meantime I hope that the above figures may prove satisfactory.

TABLE E.

TABLE worked out, showing the points of common value of Chanda and English Coal on the G. I. P. Railway at various rates. The distance from Chanda to Bombay is 546 miles, the cost of 2 tons of Chanda Coal at Chanda is assumed at Rupees 10, and supposed to be equal to only one ton of English Coal, which at Bombay costs Rupees 30 per ton.

Rate per mile of		Distance of point of common value from		Position of common point.	Cost at common point.		Table No. II.		Remarks.
							Cost at Bhoswal, 271 miles from Chanda and 273 from Bombay.		Difference in favour of Chanda Coal at Bhoswal.
2 tons from Chanda.	1 ton from Bombay.	Chanda.	Bombay.		2 tons of Chanda Coal.	1 ton of English Coal.	2 tons of Chanda Coal.	1 ton of English Coal.	
1	2	3	4	5	6	7	1	2	3
Pies.	Pies.	Miles.	Miles.		Rs. A. P.		Rs. A. P.	Rs. A. P.	Rs. A. P.
6	3	608⅜	—62⅝	Cost of 2 tons of Chanda coal at Bombay ...	.....		18 7 6	34 4 3	15 12 9
8	4	502	44	Between Titwalla and Wassind ...	30 14 8	27 1 0	21 4 8	35 10 4	14 5 8
9·14	4·57	462	84	Egutpoora*	31 15 11		22 14 5	36 8 0	13 9 7
10	5	438	108	Between Nandore and Deolallee ...	32 13 0		24 1 10	37 1 9	12 15 11
12	6	395¾	150⅝	Between Lassulgaum and Munmar...	34 11 4		26 15 0	38 8 6	11 9 6
14	7	364⅝	181¼	Between Naundgaum and Naidongree	36 9 8		29 12 2	39 15 3	10 3 1
16	8	342	204	Challisgaum	38 8 0		32 9 4	41 6 0	8 12 8
18	9	324⅜	221⅞	Between Kujgaum and Pachora ...	40 6 4		35 6 6	42 12 9	7 6 3
20	10	310	236	Between Pachora and Myjee ...	42 4 8		38 3 8	44 3 6	5 15 10

Chanda coal at these rates can be delivered in Bombay cheaper than English coal.

*Changing station at top of ghauts.

From the Executive Engineer, Kanhan Division, to the Chief Engineer, Central Provinces, dated Kamptee, 29th November 1869, No. 189—1,303.

In accordance with the instructions contained in your No. $\frac{414}{6847}$, dated 20th instant, I have the honour to submit the following report on the experiments made in this Division on the evaporating power of the Chanda coal on the 25th and 29th August last.

The engines used were the little portable engine employed in the workshops and the small locomotive working the quarry tramway.

The portable engine is of 3 H.-P. nominal, made by Messrs. Ransomes and Simms, of the usual construction, the boiler being a multo-tubular one, and the working pressure of steam 50 lbs. on the square-inch.

The locomotive is of 9 H.-P. nominal, vertical boiler, with hanging water tubes, by Messrs. Chaplin & Co., of Glasgow, the average working pressure being 100 lbs. on the square-inch.

The experiments were confined to comparisons of the quantities of water evaporated for each pound of coal (both English and Chanda) consumed, as this seems the fairest way of arriving at the relative values of both as fuel.

The accompanying table shows the results arrived at, which I think are satisfactory, considering the circumstances under which experiments were made.

In the first experiment (I. C.) the fire was lighted at 5-15 A.M., and by 6-40 steam was up to 40 lbs., when the engine was started and kept at her usual work until 12 noon, when the fire was drawn.

The coal used was saturated with water, having been exposed to heavy rain during all the previous night, and during the whole time of the experiment there was a high wind with rain.

The coal burned freely, the fire-box door having to be kept open, and the damper down during a considerable portion of the time. The fire kept perfectly clean and free from clinker, until it was drawn at the termination of the experiment; the residue being a light gray ash more like that from wood than coal.

At 1 P.M. on the same day the engine was again fired up with English coal, in order that a comparison might be made with a similar condition of weather as possible; the result of this experiment is given in the table above referred to as No. 1 E.

Experiment No. 2 C. was undertaken on the 29th August, the weather being comparatively fine; and as the fuel had been kept under a shed from the time of the first experiment, it was much drier.

The result of this experiment was much more satisfactory as regards the quantity of water evaporated, while as regards the state of the fire it was much the same. In this case also and for the same reasons the Chanda coal was experimented on during the forenoon, and English coal during the afternoon, the latter giving almost exactly the same results as on the previous occasion.

The two last experiments Nos. 3 C. and 4 C. were made with the locomotive; but, owing to the small quantity of coal at my disposal, in neither case can they be considered as giving reliable results, as they could not be continued for the whole of a day, and in the latter especially in consequence of an accidental detention, owing to an axle running hot, much more coal was consumed than was fairly due to the water evaporated.

I would remark that both the Chanda and English coal used in these experiments was much broken, and contained at least 30 per cent. of dust, and can hardly be considered as fair average specimens. The former especially had apparently been exposed for a considerable time. Much more reliable results might be obtained if the experiments were extended over a longer period, and if I had 20 or 25 tons of the Chanda coal it would enable me to give average results of the working of it for about ten days or so.

As the Superintending Engineer is absent, and I know that you require this report as early as possible, I forward it direct, and hope you will excuse my so doing.

Table of Experiments on the Comparative Evaporating Powers of Chanda and English Coal.

No. of Experiment.	Class of Engine.	Area of Grate.	No. of lbs. of Coal per sq.-ft. of grate per hour consumed.	lbs. of water evaporated by 1 lb. of coal.	Average pressure of steam on sq.-inch.	Remarks.
		sq. ft.				
1 C.	3 H.-P. Portable Tubular Boiler.	3·5	12 lbs.	4 lbs.	40 lbs.	A windy day, and the fuel damp from exposure.
2 C.	...	.....	13	4·88	40 lbs.	Weather tolerably fine and fuel drier.
3 C.	9 H.-P. Locomotive Vertical Boiler.	5·93	.....	4·25	90 lbs.	Weather fine, but during the experiment an axle ran hot, which obliged the engine to be kept standing for a considerable time. This increasing the consumption of fuel without a corresponding increase in the water evaporated.
4 C.	Hanging Water Tube	.....	23 lbs.	3·88	100 lbs.	The coal used in this experiment was the remains of the ton received to experiment on, and at least 50 per cent. of it was small coal and dust.
		English Coal (Newcastle.)				
1 E.	3 H. P. Portable, same as per Nos. 1 & 2 above.	3·5	6 lbs.	6·5	40 lbs.	The coal is stated to have been in the country for over 3 years, and therefore must be much deteriorated.
2 E.	...	.....	6·12	6·45	40 lbs.	

From the Government of India, Public Works Department, to the Chief Commissioner, Central Provinces, dated 18th June 1870, No. 1,087-R.

In acknowledging the receipt of your Officiating Secretary's letter No. 188-2,193, dated the 14th May 1870, I am directed to state that the papers therewith received, regarding trials made with Chanda coal in firing locomotives on the Great Indian Peninsula Railway, also engines at the Kanhan bridge-works, have been perused with interest by the Governor-General in Council.

2. It would appear that Chanda coal, so far as the means of carriage will allow of its transport across country, ought to be able to force its way into use on the further end of the Nagpoor Branch of the Great Indian Peninsula Railway, if, as is supposed, English coal cost the Great Indian Peninsula Railway Company at Nagpoor somewhat about Rupees 35 per ton, the equivalent of Chanda coal should be obtainable at about Rupees 27, allowing Rupees 12 a ton for its transport by road from the mines to the line. The Government of India would wish that the feasibility of this should be considered by you, so that the propriety of working the fields to a limited extent may be investigated in anticipation of the question of constructing the Branch Railway. I am to request that this may be done, and an early report on the subject submitted.

Proceedings of the Madras Government, Public Works Department, 15th November 1871.

No. 1,088-R.

Endorsed by P. W. Dept.

Copy to the Government of Bombay (Railway Branch) for information.

No. 1,088½-R.

Copy to Home Department for information.

From the Acting Secretary to the Government of Bombay, in the Public Works Department, Railway Branch, to the Secretary to the Government of India, Public Works Department, dated 5th July 1870, No. 948.

In continuation of my letter No. 845 of 13th June 1870, I am directed to forward further correspondence about Mowpani coal, and to state that the Company have now got down about 80 tons to Bombay to conduct experiments with under the immediate supervision of the Locomotive Superintendent.

From H. P. LeMESURIER, Esq., Agent, G. I. P. Railway Company, to the Consulting Engineer for Railways, Bombay, dated 25th June 1870, No. 5,124.

With reference to Government Resolution No. 1861 of 1870 and your letter No. 2,063 of the 20th June, on the subject of the Mowpani coal, I beg to state that the Locomotive Superintendent had already been instructed to make a series of experiments. His orders were to obtain 100 tons of coal from each of the two mines, and to have two or three engines altered and regularly worked with it for two or three months, or until he had satisfied himself as to the best mode of securing advantageous working. The services of Mr. Guterslop were also placed at the disposal of Mr. Hawkins to assist him in the experiments.

In the last paragraph of my demi-official letter No. 4,329 of the 26th ultimo, I informed you that instructions had been issued to Mr. Hawkins, and you will observe that they embody the suggestions made in your letter No. 2,063 of 20th instant.

I enclose herewith copies of the preliminary reports I have received. Mr. Hawkins has been desired to arrange for Captain LeMesurier to be present when the further trials are made, and the result shall be duly communicated to Government.

I must be allowed to say that comment from Mr. Adley on the action of the Great Indian Peninsula Railway is at least uncalled for. Had the Nerbudda Coal Company held out fair and reasonable inducements, and offered their coal to the Great Inlian Peninsula Railway on favourable terms, the delay in pushing on the Branch Railway would perhaps not have arisen, knowing, as we do, that the cost of coal and coke per train-mile on the Great Indian Peninsula Railway for the second-half of 1869 was as high as 8·40 Annas, as against 3·05 Annas on the East Indian Railway; it is hardly to be supposed that we can be indifferent to the satisfactory solution of the important question.

From C. W. HAWKINS, Esq., Locomotive Superintendent, to the Agent, Great Indian Peninsula Railway Company, dated 1st June 1870, No. 1,001.

I had already been in communication with Mr. Knoles, asking him to arrange with Mr. Thompson to try any plan by which the success of the Mowpani coal could, in his opinion, be secured, and I attach copy of his answer. I have to-day given the necessary instructions for getting a supply from Mr. Knolles and the Nerbudda Company. The engines with which the trials were made had their fire-bars altered so as to give more space between the bars. I have asked Mr. Knolles to offer any other suggestion, and I will have them carried out, and I shall be very glad to have the assistance of Mr. Guterslop in making the experiments. Judging from what I saw of the Nerbudda Company's coal, I should say it is much more unsuitable for our purpose than Mr. Knolles's. I

think also it is possible that Mr. Knolles may find his seam get better as he gets further in at present. We appear to be making experiments with a lot of rubbish. I do not know whether you heard of the results of the last trial, but they were very bad; they could not get on the road at all, and stopped the mail two hours; at the same time I think the coal had scarcely a fair trial as the engine primed a good deal.

With respect to your remarks in your No. 4,330, *re* locomotives in other parts of the world burning as bad coal as the Mowpani, I should wish to point out that, where this is the case, it has generally been known before the line was made that they would have to burn bad coal, and engines are therefore built specially suited for that purpose with larger fire-boxes, special combustion chambers, and various other contrivances which we neither have nor could apply to our existing engines, and also that this bad coal is generally used on lines where time is no particular object. In conclusion, I beg to assure you that nothing will give me greater pleasure than to see Mowpani coal answer, and that I shall use every endeavour to make it do so.

Since writing the above, I have seen Mr. Knolles, and he tells me that he could not get 100 tons delivered before the rains, but that there is a large stock both of his coal and the Nerbudda Company's lying at Gurrawarra in the engineers' hands; this, I presume, I can use if I cannot get enough otherwise.

From T. H. W. KNOLLES, Esq., to the Locomotive Superintendent, G. I. P. Railway Company, dated 26th May 1870.

I HAVE pleasure to acknowledge the receipt of yours of the 23rd instant. I shall, as requested by you, place myself in communication with Mr. Thompson as to the alterations necessary.

Would you kindly order a trial of the Nerbudda coal, both by itself and mixed with the Mowpani? I think the trial will not be satisfactory.

I understand Mr. Thompson to say that even supposing the Mowpani coal (that is, the seams I am now working) was not of a quality suitable for use on a long journey, still it would be all that was required for shunting and standing engines. As the quantity you will take as per agreement is not a large one, could you not let me stack a quantity for this purpose; this would enable me to explore the place more thoroughly and probably get you a very superior article; as it is, at present, the place is hardly opened out, or the quality of the seams ascertained.

Trusting you will be able to comply with this request, I have etc.

From G. H. WRIGHT, Esq., District Resident Engineer, Jubbelpoor, to the Acting Chief Engineer, North Eastern Division, dated 23rd May 1870, No. 589-G.

Trial of Mr. Knolles's Coal.

I BEG to forward, for the information of yourself and Agent, the accompanying report from Mr. Guterslop on a trial made with Mr. Knolles's coal in one of the Company's goods engines to which were attached 25 vehicles, forming an ordinarily sized goods' train. I regret to say that the trial was by no means a satisfactory one The steam fell to a low pressure after the train had gone a few miles on its journey, and by no measures that were taken could it be raised again and kept at the pressure required. I am much disappointed with the result of this trial, as I had quite expected it to prove a satisfactory one. The coal has been used for some time past with success in our small ballast engines, stationery engine, forges, &c., but it must, of course, be admitted that such a test of its qualities was not nearly so severe as that to which it has just been put.

I am of Mr. Guterslop's opinion that a further trial should be made before the coal is condemned for locomotive purposes, and I think the suggestions he makes about altering the draft combustion, and using a rocking fire-grate for getting rid of clinkers, are well worthy of consideration.

Mr. Guterslop has had great experience with coal of various descriptions in America, and is well qualified to give an opinion upon the natter in question with which the Company's interests are so closely connected.

Report by F. GUTERSLOP, Esq., to the Agent and Chief Engineer, Great Indian Peninsula Railway, dated 22nd May, 1870.

Trial of Mr. Knolles's Coal.

IN compliance with your resolution, authorizing me to be present at the coal trials, I have made a trial with Mr. Thompson and Mr. Knolles, and beg leave to submit the following:—

We had a six-wheeled coupled engined cyl. 17″ × 24, 18 loaded waggons, 6 carriages, and 1 brake-van.

The only alterations made to make her fit for burning the coal was the spaces between the grate-bars enlarged to 1½ inch from, I think, ¾ inches formerly. The grate was inclined about 12 inches, and length of fire-box from 5 to 6 feet.

The engine was very dirty and priming very much; she was fixed up by mistake with English coal, but none but Knolles's coal on the tender.

We started with 120 pounds of steam, falling after 8 miles run to 60 pounds, and after a few miles more to 50, which was scarcely sufficient to pull the heavy train along.

We picked a load of old sleepers up, and commenced firing solely with them, with which we could keep up only 60 pounds of steam.

It is well-known an expert engine-driver can burn either 1 ton or 2 tons of fuel in doing the same work; the wheels, journals, springs, valve motion, rubbing surfaces, cleanliness of feed-water and boiler, condition of permanent-way, protection of boiler and cylinder against condensation, the line of the axles and working parts, and other variable important elements of economy or loss may each so modify the general result that to measure either by the general result is wholly unsatisfactory.

To give the coal a fair trial a Dynnamometer and Indicator should be used which will do away with all approximation and guess-work.

The engine should be clean and a few more alterations are to be made with grate and fire-box, and I may add the spark arrester generally so stopped up with soot that it does not allow a good free draft, which is absolutely necessary for Mr. Knolles's coal.

Allow me to make a few remarks about burning bituminous coal.

No substance is combustible of itself to whatever degree of heat it may be exposed. It can only be ignited when in presence of air or its vital element, oxygen, and combustion can only be made to exist by maintaining the necessary heat in the combustible mixture to ignite it.

Suppose the engine being in motion, we observe some or all of the following results after bituminous coal is put into the fire-box.

For the first few minutes the flame is darkened, or nearly extinguished, the pressure of steam goes down, and the dense cloud of smoke and fire sparks come from the chimney. If the coal is very sulphurous, this smoke has the stench of rotton eggs.

After some minutes the fire becomes bright, the escape of smoke diminishes, and the steam-pressure rises to its maximum point.

After some further time the grate becomes perhaps clogged with clinker, and the surface of the fire sinks.

Allowing the fire to burn down, and bringing the engine to a stop, we find considerable fine coal in the smoke-box, and the flues are coated with soot.

The smoke which escapes from the chimney will deposit soot on any surface exposed to it, while the dense vapours formed in the fire-box will not. Hence whatever may be the visible resemblance between the dark cloud as distilled at the coal, and the smoke at the chimney top, they are evidently different. Besides, the dark vapours in the furnace ignites and gives out flame as the air gains access to it, while the smoke once formed cannot be burned by any practicable means by heating, mixing with air, or otherwise.

If we provide means for watching the course of the flame, we find it never enters a flue of ordinary size for more than a few inches from its mouth. The flame is extinguished immediately on entering them. Hence all the combustible matter contained in the flame at the moment of its extrication is lost, as it can only impart its full heat by its complete combustion.

The heating value of any fuel is exactly proportional to the quantity of air with which it will combine in combustion.

The hydrogen in coal which combines with three times the quantity of air which would be taken up by carbon has for equal weights three times the heating value; therefore the 100 pounds of pure hydrogen in a ton of coal have the same heating efficacy as that due to 300 pounds of the remaining corbon or pure coke.

Where these combinations are completed, combination will be perfect. A given quantity of gas completely burned cannot produce smoke, since smoke contains a quantity of unburnt matter, and is in itself a proof of incomplete combustion.

The products of perfect combustion are invisible being for carbon and oxygen carbonic acid, and for hydrogen and oxygen invisible steam which condenses to water.

So far as the structure of the furnace may aid these chemical combustions by giving room, direction and time for mechanical mixture, and ignition, so far will the furnace be efficient in burning coal completely, which is the same as burning it economically.

Among the most essential provisions in the arrangement of the furnace are those which operate to induce the mingling of the coal gas and air, since both are to be burned, and, as we have seen, neither can burn without the other, they can only burn together.

Thus, wherever the air is induced to enter by the draft, whether through the grate or through openings in the door, the admission spaces should be small and numerous, so as to present as many surfaces as possible, and not by opening the fire-door wide which admits the air in bulks, going straight through the flues without touching the surface of the fire where the air is required.

Let us now see what is necessary to meet the requirements for burning the bituminous coal as near as possible smokeless, or what is the same, economically.

We want sufficient space for the mixture of the gas with air. If the ordinary fire-box does not afford room, we must obtain it by a combustion-chamber, and by fixing in the fire-box in front of the grate, a dead-plate which can be made turning around a shaft and used for dropping the fire. The combustion-chamber, say, only 6 inches long, will add to the space, and at the same time move the flue-sheet from the intense heat of the fire, helping the flues to keep longer and better tight.

We want sufficient air. The greatest amount when fresh coal is put in, and the fire the thickest, the least can get through the grate, so that, as far as the air supply regulates itself, it is exactly opposite to the requirements of the case. The now used shovel or hood in the fire-door does not admit air in a bulk, gives it a downward direction, preventing it from going useless through the flues and spreads it over the grate. Besides this, six tubes 1¼ or 2 inches diameter in the front leg of the fire-box little above the fire, have been found very effective smoke-preventer.

After the gas of the coal has been burnt, and the coke commences finding, we have too much air for this process, we shut the damper and fire-door, and admit only air through these tubes unless we prefer to keep the damper open. In that case, a plain plate with corresponding holes fastened in front of the short tubes, can easily be moved to shut them.

Lastly, for breaking the clinker or keeping the grate clean, a rocking grate worked now and then by hand-lever is all required.

No. 317 A., dated 1st June 1870.

Endorsed by Acting Chief Engineer.

Copy forwarded to the Agent for information, with reference to his No. 3,091, dated 19th April 1870.

From the Acting Secretary to the Government of Bombay, to the Secretary to the Government of India, Public Works Department, (Railway,) Simla, dated Bombay Castle, 2nd August 1870, No. 1,089.

I am directed to transmit, for the information of the Government of India, a report of some trials made with Nerbudda and English coal by the Bombay, Baroda, and Central India Railway Company.

Proceedings of the Madras Government, Public Works Department,
15th November 1871.

BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY.

Experimental trials of Nerbudda Coal with different descriptions of English Coal.

The Engine used in these experiments was No. 39, six-wheeled, four-wheel coupled. Cylinders, 16 inches diameter, 22 inches stroke. Fire-box fitted with brick-arch, and iron scoop in fire-door; the fire-grate and blast-pipe were altered as found necessary for the Nerbudda Coal.

Date.	Train.	Number of Carriages.	Weight of train exclusive of engine.	Total weight of train.	Train-mile run.	Average speed including stoppage.	Average pressure of steam.	Time with train.	Coal consumed with train.			Water evaporated with train.		Coal used in getting up steam.	Ashes.		Distance apart of fire-bars.	Diameter of blast-pipe.	Wind and weather.	Description of Coal.	Remarks.
									Quantity.	Per mile.	Per ton per mile.	Quantity.	Per lb. of coal.		Total clean-ity.	Percentage.					
1870.			Tons.	Tons.		Miles per hour.	lbs.	Hrs.	lbs.	lbs.	lbs.	lbs.	lbs.		lbs.		Inch.	Inch.			
July. 6th	*Nerbudda Coal.* Through passenger between Bombay and Surat.	16	132	180	163½	25	80	8·5	6,496	39·79	221	40,353	6·21	448	1,123	16·18	½	4½	Showery, light breeze with the train.		
	Bombay to Surat...																				
9th	Do. do. ...	16	122	170	...	..	84	7·55	6,720	41·16	242	38,860	5·78	448	1,463	20·4	1	4½	Fair, no wind.	*English Coal.* The same coal.	Fifteen minutes lost cleaning fire; the rest of the time lost for traffic; could not make it up; engine did not steam well.
12th	Do. do. ...	16	128	176	...	...	97	7·20	6,944	42·53	241	37,290	5·37	448	1,478	20·	1	4½	Showery, moderate breeze with the train.		Twenty-nine minutes lost cleaning fire; 5 minutes made up; 24 minutes late at Surat; engine steamed a little better with the alteration in fire-grate.
	English Coal.																				
7th	Surat to Bombay...	16	127	175	...	...	105	7·35	6,104	37·39	213	38,070	6·23	448	636	9·7	½	4½	Fair, light breeze against the train.	Second class English coal, not new.	Fifteen minutes lost cleaning fire; 15 minutes made up; engine steamed well with alteration of blast-pipe and fire-grate.
10th	Do. do. ...	15	117	165	...	...	107	7·35	5,712	34·99	212	39,180	6·86	448	571	9·36	½	4½	Fair, no wind.		
15th	Bombay to Surat...	15	120	168	...	...	110	7·20	4,928	30·2	180	39,530	8·02	448	457	8·5	½	4½	Fair, moderate breeze with the train.	Best new English coal.	No time lost; engine steamed very well.

Note.—In all the experiments with Nerbudda Coal, the smoke was consumed, and none visible at the funnel. With English Coal the smoke was not entirely consumed.

(Signed) E. B. CARROLL,
Locomotive and Carriage Supdt.

found to be of better quality as compared

From the Secretary to the Government of India, Public Works Department, to the Acting Secretary to the Government of Bombay, Public Works Department, (Railway,) dated Simla, 16th August 1870, No. 1,434-R.

In acknowledging the receipt of your letter No. 1,089 of the 2nd instant, with its enclosed report of some trials made with Nerbudda and English coal by the Bombay, Baroda, and Central India Railway Company, I am directed to enquire whether the Nerbudda coal, with which these experiments were made, was purchased from the Nerbudda Coal Company or Mr. Knolles.

From the Secretary to the Government of Bombay, Public Works Department, Railway Branch- to the Secretary to the Government of India, Public Works Department, dated 6th September 1870, No. 1,242.

In reply to your letter No. 1,434-R., dated 16th August 1870, I have the honour to inform you that the coal in question was from the Nerbudda Coal Company's mines. Some further reports are attached. The trials made by the Great Indian Peninsula Railway have also proved satisfactory.

found to be of better quality as compared with

Proceedings of the Madras Government, Public Works Department,
15th November 1871.

BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY.

Experimental trials of Nerbudda Coal with different descriptions of English and Australian.

PASSENGER TRAINS.—The Engine used in these experiments was No. 39, six-wheeled, four-wheel coupled. Cylinders 16 inches diameter, 22 inches stroke. Fire-box fitted with brick-arch, and iron scoop in fire-door; the fire-grate and blast-pipe were altered.

Date.	Train.	Number of Carriages.	Weight of train exclusive of engine.	Total weight of train.	Train-miles run.	Average speed, including stoppages.	Average pressure of steam.	Time with train.	Coal consumed with train.			Water evaporated with train.		Coal used in getting up steam.	Ashes.		Distance apart of fire-bars.	Diameter of blast-pipe.	Wind and weather.	Description of Coal.	Remarks.
									Quantity.	Per train-mile.	Per ton per mile.	Quantity.	Per lb. of coal.		Total quantity.	Percentage.					
1870. July.	*Nerbudda Coal.*		Tons.	Tons.		Miles per hour.	lbs.	Hrs.	lbs.	lbs.	lbs.	lbs.	lbs.		lbs.		Inch.	Inch.			
6th	Bombay to Surat...	16	132	180	163¼	...	80	8·5	6,496	39·79	221	40,353	6·21	448	1,123	16·13	¼	4½	Showery, light breeze with the train.	The same coal.	Fifteen minutes lost cleaning fire; the rest of the time for traffic could not make it up; engine did not steam well.
9th	Do. do. ...	16	122	170	...	...	84	7·65	6,720	41·16	242	38,800	5·78	448	1,463	2·04	1	4½	Fair, no wind.		Twenty-nine minutes lost cleaning fire; 5 minutes made up; 24 minutes late at Surat; engine steamed a little better with alteration in grate.
12th	Do. do. ...	16	128	176	...	...	97	7·20	6,944	42·63	241	37,290	5·37	448	1,473	·20	1	4½	Showery, moderate breeze with the train.		Fifteen minutes lost cleaning fire; 15 minutes made up; engine steamed well with the alteration of blast-pipe and fire-grate.
	English Coal.																				
7th	Surat to Bombay...	16	127	175	...	...	105	7·35	6,104	37·39	213	33,970	6·33	448	636	9·7	¼	4½	Fair, light breeze against the train.	Second class English coal, not new.	No time lost, engine steamed very well.
10th	Do. do. ...	15	117	165	...	...	107	7·35	5,712	34·99	212	30,180	6·36	448	571	9·26	¼	4½	Fair, no wind.		
15th	Bombay to Surat...	15	120	168	...	...	110	7·30	4,923	30·2	180	29,530	8·02	448	457	8·5	¼	4½	Fair, moderate breeze with the train.	Best new English coal.	
	Australian Coal.																				
Aug. 23rd.	Bombay to Surat...	12	97	145	...	...	100	7·20	4,592	28·13	194	30,510	8·6	448	366	6·66	¼	4½	Fair, light breeze with the train.	Best new Australian coal.	Arrived in right time; engine steamed well.
24th	Surat to Bombay...	12	96	144	...	...	100	7·35	4,308	26·75	185	35,610	8·15	448	244	6·4	¼	4½			

(Signed) E. B. CARROLL,
Locomotive and Carriage Supdt.

PAREL,
August 1870.

BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY.

Experimental trials with different descriptions of Coal.

GOODS' TRAINS.—The Engine used in these experiments was No. 54, six-wheeled, six-wheel coupled. Cylinders 18 inches diameter, 24 inches stroke. Fire-box without the brick-arch, and iron scoop in fire-door.

Date.	Train.	Number of waggons.	Weight of train exclusive of engine.	Total weight of train.	Train-miles run.	Average speed including stopping.	Average pressure of steam.	Time with train.	Coal consumed with the train.		Water evaporated with the train.		Coal used in getting up steam.	Ashes.		Distance apart of fire-bars.	Diameter of blast-pipe.	Wind and weather.	Description of Coal.	Remarks.
									Quantity.	Per train.	Quantity.	Per lb. of Coal.		Total quantity.	Percentage.					
1870.	Between Bombay and Golwood.		Tons.	Tons.		Miles per hour.	lbs.	Hrs.	lbs.	lbs.	lbs.	lbs.		lbs.		Inch.	Inch.			
July.	*Nerbudda Coal.*																			
22nd	Bombay to Golwood	51	430	453	81½	12	84	10·25	9,520	186·8	50,040	5·25	560	2,000	·20		1	4½	Showery, moderate breeze with the train.	.....	Fifty-five minutes lost by slow driving, 25 minutes at stations cleaning fire and raising steam, total 80 minutes; could not make it up, as the engine did not steam well.
	English Coal.																			
23rd	Golwood to Bombay	64	304	447	...	16	112	7·10	7,168	87·95	49,690	6·93	560	717	10·7		¼	4½	Fair, strong breeze against the train.	Boet new English Coal.	No time lost; engine steamed well.
Aug.	Bombay to Golwood	48	517	565	...	...	107	8·10	6,720	83·45	45,360	6·75	560	711	10·23		¼	4½	Fair, moderate breeze with the train.		Arrived at Golwood right time; engine steamed well.
1st	Golwood to Bombay	65	375	423	...	...	102	9·	7,952	230	55,030	6·92	...	750	10·6		¼	4½	Fair, strong breeze against the train.		The engine ran to time, and steamed well, the delay was caused through waiting at stations.

(Signed) E. B. CARROLL,
Locomotive and Carriage Supdt.

PAREL,
August 1870.

From H. J. P. THOMPSON, Esq., Secretary to the Agent, G. I. P. Railway Company, to the Consulting Engineer for Railways, Bombay, dated 31st August 1870, No. 7,148.

I AM directed to forward, for your information, copies of reports from the Locomotive Superintendent of further trials made with Mowpani Coal.

Demi-official letter from C. W. HAWKINS, Esq., Locomotive Superintendent, to H. P. LEMESURIER, Esq., dated 9th August 1870, No. 1,241.

I HAVE the pleasure to hand you a report of a further trial of the Mowpani Coal mixed with one-fifth of coke. You will see that from the Inspector's report it still clinkers badly even when mixed. The experiments are being continued.

Remarks by W. WILKS, Esq., on experiments with Coal—Bombay to Kurjut.

RAN before time into Bhandoop, and steamed very well; pricked up the fire, and did not notice any quantity of clinker; kept from 80 lbs. to 100 lbs. steam between Bhandoop and Callian; lever worked in 2nd and 3rd notch, and regulator from ¼ to ¾ open. Ran into Callian before time to get the fire well cleaned. Upwards of one basket full of clinkers were taken out, varying from 4 to 10 inches in thickness. Left Callian with a bright fire, full boiler of water, and 120 lbs. steam; had some difficulty in getting over the bank between Callian and Budlapoor; could not get more than 90 lbs. steam. On arrival at Budlapoor, found the bars partly covered with clinker; blew up the fire, and started from Budlapoor with 120 lbs. steam and full boiler; had to work with lever right over, and regulator wide open; could not keep more than 80 lbs. steam on the banks; and on nearing Narel, steam continued to drop. Ran into Narel with only 10 lbs. steam, and water-level with bottom nut of gauge glass column; 55 minutes were occupied at Narel, cleaning the fire, filling the boiler, and obtaining 100 lbs. of steam. The bars were entirely covered, clinkers varying from 4 to 10 inches in thickness. Started from Narel with 190 lbs. steam; worked with lever over and regulator wide open. Steam continued to drop the whole distance between Narel and Kurjut. Ran into Kurjut with 20 lbs. steam, and water-level with bottom nut of gauge glass column. Train having to be put away into a siding after arrival, 25 minutes were occupied in blowing up to 80 lbs. steam to do so. Did not stick between sta[illegible]. Bars in fire-box, 15.

Remarks by W. WILKS, Esq., on experiments with Coal, Kurjut to Bombay.

STEAMED very well to Callian; took out a good basket full of clinkers, varying from 3 to 8 inches in thickness; did not steam so well from Callian to Bombay as from Kurjut to Callian, but kept a little before time at all stations; had to blow up at all stations; pricked the fire up at Bhandoop. Did not stick between stations. Number of bars in fire-box, 14.

From C. W. HAWKINS, Esq., Locomotive Superintendent, to H. P. LEMESURIER, Esq., dated 22nd August 1870, No. 1,296.

HEREWITH I have the pleasure of sending you two more reports of trials with Mowpani coal. In each case 60 cwt. of coal and 15 of coke was the proportion. I hope soon to receive a better specimen from Mr. Jones. We are now commencing to try the Nerbudda Company's coal.

Remarks by W. WILKS, Esq., on trial of Mowpani Coal—trip from Bombay to Kussara.

STOPPED at Bhandoop to prick up fire and take water; steamed very fair to Callian; cleaned the fire at Callian; took out a good quantity of clinker, varying from 4 to 10 inches in thickness. After leaving Callian, steam dropped from 120 lbs. to 80 and 60 lbs. Stopped at Titwalla 10 minutes to blow up to 120 lbs. After leaving Titwalla, steam dropped to 80 and 60 lbs.; 1 hour and 15 minutes occupied at Wassind, cleaning fire, and getting 120 lbs. steam; 45 minutes late start from Wassind in consequence; steam dropped to 40 lbs. nearing Shawpoor. Stopped at Shawpoor 45 minutes to prick up fire, and get 100 lbs. steam. Stopped about 2 miles from Shawpoor, having only 30 lbs. steam; pricked the fire, and blew up to 80 lbs.; time occupied 40 minutes. Ran about one mile and a half when the steam again dropped to 30 lbs; stopped and cleaned the fire; the bars were covered with clinkers, about 1 foot in thickness; time occupied 1 hour. Stopped at Atgaum and Khurdee to blow up. Total time lost between Wassind and Kussara, 2 hours and 25 minutes.

From the Joint Secretary to the Government of Bengal, Public Works Department, Railway Branch, to the Secretary to the Government of India, Public Works Department, dated 8th May 1871, No. 922-G.

IN compliance with the request contained in Public Works Department, No. 1,436, R., dated 16th August last, I am directed to forward the accompanying copy of a statement showing the results of the trials which have been made on the East Indian Railway with coal obtained from the Nerbudda Coal Company, and to observe that, with a grate suited to it, this coal appears to give satisfactory results. The Board of Agency have recently ordered another 500 tons for experimental consumption.

Proceedings of the Madras Government, Public Works Department,
15th November 1871.

Trial of Ranegunge and Nerbudda Coal with Engine No. 402, working No. 6 up Locomotive Coal Trains between Allahabad and Cawnpore.

Miles.	Spread of Train.	Number of Vehicles.	Weight of Train with Engine and Tender in Tons.	Consumption. Coal in Tons	Consumption. Water in Gallons.	Coal per mile in Pounds.	Evaporation. Per mile in Gallons.	Evaporation. Per pound of Coal in Gallons.	Pounds of Coal per ton of load.	Gallons of Water per ton of load.	Pounds of Coal per ton of load per mile.	Gallons of Water per ton of load per mile.	Ashes in Cwt.	Remarks.
			Nerbudda Coal, Saturday, 14th January 1871.											
119½	19½ miles	80	439·0	8·15	4,040	70·29	83·47	0·43	19·13	9·20	0·16	0·76	...	5 cwt. coal in addition for lighting engine; weather very fine, no wind and no detentions.
			Ranegunge Coal, Friday, 20th January 1871.											
119½	19½ miles	83	463·0	8·10	4,433	65·6	87·51	0·57	16·93	9·68	0·14	0·81	...	5 cwt. coal in addition for lighting; strong head wind blowing, and long detentions.
			Nerbudda Coal, Tuesday, 7th February 1871.											
119½	19½ miles	81	437·0	8·9	...	64·66	...	...	17·63	...	0·14	...	...	5 cwt. coal in addition for lighting engine; weather fine, no wind and no detentions.

I was present at the trial of the Nerbudda Coal on the 14th January, and went on the engine as far as Futtehpore. The circumstances were all decidedly favourable, fine still weather, and no delays. I cannot certify as to result, because I was not present at the weighing in and weighing out of the fuel. The coal struck me as being a favourable specimen, judging from what I have seen of it before; it is, I should say, deficient in bituminous matter, and requires a good draught. On the whole, I am of opinion that the trial was satisfactory. I was not present at the trial of the Ranegunge Coal.

(Sd.) J. BONUS, Major, R. E.,
Dy. Consg. Engr.
to Govt., N. W. P.

found to be of better quality as compared with

Trial of Raneegunge and Nerbudda Coal with Engine No. 450, working No. 6 up Locomotive Coal Trains between Newadee and Dinapore.

Miles.	Speed of Train.	Number of Vehicles.	Weight of Train with Engine and Tender in Tons.	Consumption. Coal in Tons.	Consumption. Water in Gallons.	Evaporation. Coal per mile in Pounds.	Evaporation. Water per mile in Gallons.	Evaporation. Per pound of Coal in Gallons.	Pound of Coal per ton of load.	Gallons of Water per ton of load.	Pounds of Coal per ton of load per mile.	Gallons of Water per ton of load per mile.	Ashes in Cwt.	Remarks.

without success. Another thin seam, only 2 feet thick, has also been detected by Mr. VanStavern on the right bank of the river. This, like the two first met with, thins out within a few yards in one direction.

I reached Dumagudem on the 25th December 1870, and learned from Colonel Haig that besides the coal at Lingala near the mouth of the Tal, some had been reported farther down the river at a village named Madavaram below Bhadrachalam. This place is below the first barrier on the Godavery, and is consequently at all times in free communication by water with the coast, whilst Lingala is above the first barrier, and although communication is now possible during the greater part of the year, it is not easy for laden boats except for a few months. At the spot where coal was said to have been found, I could detect nothing except some shaly dark-coloured sandstone, but the rocks around were unmistakably Damudas, and there was every reason to hope for success in the search.

An examination of the ground showed that the Damuda rocks extend for a short distance on both banks of the river, but that sections are very few and imperfect. On the left bank which belongs to the Upper Godavery* Districts, there are scarcely any rocks visible except at the hills near Daorpali, and these are probably of a higher group, nearly the whole surface elsewhere being covered with alluvium. The beds appear to extend about six miles along the river from Gogubaka to Nandigur, but not more than from a mile to a mile and-a-half from the bank. On the right (south) bank of the river they extend about five miles from Palaram to the bend below Madavaram, stretching for a mile and-a-half to two miles inland. Above Palaram there is a break occupied by metamorphic rocks for a mile and-a-half; above this, again, at Pundigul the Damudas reappear and occur for about one and-a-half miles to a little above Amravaram, then they are covered apparently by the Kamthis; but the two groups here resemble each other so much in mineral character that their limits are difficult to define, especially as nearly the whole surface of the country is thickly covered with alluvial deposit. The Damudas near Amravaram cannot be tracde more than about a mile and-a-half from the river's banks; beyond this limit they are entirely overlapped by the Kamthis.

Along the right (or south) bank of the Godavery a tolerable section of the Damudas is exposed, consisting of conglomerate, sandstone, shale and clay, but no coal. There are, however, many breaks in the section, and it is evident that an examination of these by boring would prove conclusively the presence or absence of any bed of coal extending over the whole field. Local beds, of course, might be found elsewhere, but their value must be comparatively small. It is also manifest that a thorough exploration can only be made south of the river, as to the north the beds are so much concealed that, except in a few spots, all borings must be put down at haphazard.

The general dip seen in the river's bank near Madavaram is to the westward, the rocks at the village being inclined at a high angle and much broken and disturbed; a short distance to the east down the river is an anticlinal, at the spot where a small stream enters the river. From this point eastwards to the bend of the river, a distance of less than a quarter of a mile, the rocks either have a low dip to the east or are horizontal, and the prevalence of conglomerate shows them to be in all probability near the base or limit of the formation.

It is evident that the anticlinal exposes the lowest rocks to be seen on the river-bank, and that a boring at this spot must penetrate beds lower in the series than any exposed elsewhere. On the arrival of the boring tools, I arranged with Mr. VanStavern for a borehole to be begun at his spot. This was commenced on January 17th, and carried on until April 12th, up to which time 192 feet had been penetrated; the borehole was then stopped in consequence of the tools

* I do not know who bestowed this name on the districts, but it is an absurd misnomer. The Upper Godavery can only be that portion of the river's course above its junction with the Pranhita, if not higher still where it traverses the Bombay Presidency. Sironcha at the upper extremity of these—"Upper Godavery Districts"—is 210 miles as the crow flies from the mouth of the river, and 400 miles from its source!

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being required to prove the coal discovered on the opposite side of the river. The section passed through was—

		Ft.	In.
1.	Brown sandstone	24	6
2.	Shale and clay of various colours, mostly dark-grey	21	1
3.	Coal and shale mixed	0	6
	Dark-grey shale	0	7
	Do. do. with fragments of coal ...	0	8
	Do. do.	18	9
4.	White sandstone conglomeratic in places, with thin beds of shale towards the base	53	9
5.	Shale and clay with a little sandstone ...	37	2
6.	Coal	0	8
	Black shale and coal	1	4
7.	Dark-grey shale with a few fragments of coal in two places	26	1
8.	White sandstone	8	4
	Total ...	193	5

I next arranged for a series of fourteen borings to explore the portions of the section not exposed in the river banks to the west of Madavaram between that village and Damarcherla These varied in depth from 6 to 200 feet, according to the extent of the breaks in the section, and the plan proposed was that all the smaller boreholes not exceeding 35 feet in depth, nine in number, should be made by jumpers with extra lengths of light rods to screw on. The remaining five boreholes alone would require the use of the heavier boring rods. In the ground opposite Madavaram no boreholes were put, because the breaks on the section are trifling, and the disturbance so great that there is reason to believe that a repetition of beds takes place.

To the west of Damarcherla one or two additional boreholes might have been required, but a little beyond the village the beds turn up, dipping east, and then roll over again, and just beyond the small anticlinal, very unpromising conglomerates, perhaps belonging to a higher group, come in, in which there is no break of section which could conceal a coal seam. Two or three small jumper holes were put down to the east of Madavaram.

* * * * * *

It should be stated that the borings, so far as they had been carried out on the right bank, had shown the existence of sandstones and shales similar in every respect to those seen in the bank of the river, except that in two or three instances small fragments of coal proving the existence of very thin seams, probably not exceeding two or three inches in thickness, had been brought up by the borer. These little seams, although absolutely worthless in themselves, are of importance, as indicating that the mineral does occur in the beds, and that hopes may be entertained of larger seams being found.

The place selected for a boring on the north or British bank of the Godavery was on the right or west bank of a stream called the Ganar, rather less than half a mile from the Godavery, and about the same distance east of the village of Tatpali, at a spot where some brown sandstone, dipping to the south, is seen on the bank of the watercourse. A little more sandstone of the same kind is seen up the stream to the north, and then metamorphics crop out, the latter appearing about 500 yards north of the spot selected for boring. For some distance east and west all is alluvium. It was hoped that a borehole at the spot selected would afford a section of the lowest Damuda beds, lower

than any passed through in the boring east of Madavaram. The borehole was commenced on the 12th April, and the section traversed was—

		Ft.	In.
(No. 1).	Soil and gravel	8	6
*1.—	Brown and yellow sandstone...	25	6
2.	Shale, pale above, darker below	7	0
	Coal	3	0
	Do. mixed with shale	1	0
	Dark carbonaceous shale	5	0
	Coal	3	0
	Dark shale with 2 inches coal	6	0
3.—	White sandstone	27	0
		86	0

The higher 3 feet of coal appears to be of better quality than the lower ; an analysis of the small fragments washed from the samples brought up from the borehole gave the following (average of three samples from three different levels) :—

Volatile	37·7
Carbon	42·7
Ash	19·6
	100·0

The volatile portion comprised 10·8 per cent. of water. This is by no means a good result, but still some use could be made of such coal, and it should be remembered that analyses of such samples as are obtained from borings are only approximations, although they are usually not far from the true composition.

When I heard of the discovery of coal I was about forty miles from the spot. I marched to it at once, but before I reached it, Mr. Heppel, who was carrying on the borings, had commenced a second borehole on some sandstone in the bed of the Ganar stream below No. 1 borehole at a distance from the first of 125 yards south-east by east. This (No. 2) gave the following remarkable section :—

		Ft.	In.
(No. 2).	1.—Yellow and brown sandstone	28	0
	Shale, partly dark-grey, partly buff	1	6
	Coal	2	0
	Shale	2	2
	Coal	0	6
	Shale	0	6
	Coal	1	4
	Shale	1	4
	Coal	1	0
	Shale	1	2
2.—	*Coal*	1	8
	Shale	1	2
	Coal	1	11
	Shale	0	10
	Coal	1	0
	Shale	2	8
	Coal (shaly)	1	9
	Shale	1	4
	Coal	0	8
	Black shale	5	0
3.—	White sandstone.	3	2
		60	8

Altogether the combined bed of shale and coal measures 29 feet 6 inches, of which 11 feet 8 inches is coal, but the bands of coal and shale are intermixed in a way, which would much increase the cost of working the seam. The astonishing change, however, in so short a distance as 125 yards from a bed 25 feet thick containing 7 feet of coal in two well defined seams exceeds anything usual even in India, amongst the very variable seams sometimes met with in the Barakar group,

*The numbers 1, 2, 3, before the several beds in the sections, indicate those which are supposed to be representative of the same part of the series in each.

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and this amount of change within so short a distance rendered it doubtful whether the seam could be traced to any distance.

Of the holes proposed six were carried out, *viz.*, four jumper holes and two boreholes, when peremptory orders were received from the Government of India to discontinue all boring operations in the Nizam's dominions. It is doubtful whether the bore holes in the bed of the river were in the Nizam's dominions, but, pending a reference to the Government of the Central Provinces, one set of boring tools was moved across the river into British territory, in order to test some ground near the boundary of the field, and close to the base of the measures, on a horizon which did not appear to have been proved by the borings on the opposite bank.

It was now desirable, 1*st*, to ascertain the extent of the seam, and 2*nd*, its quality. For the extent two boreholes were put down, one to the east, the other to the west, at a distance of about one-third of a mile from No. 1 on the supposed strike of the coal seam. All the ground east and west for a considerable distance being completely covered by alluvium, the true strike could only be inferred from the line of outcrop of the metamorphic rocks to the northward. To the east the borehole (No. 4) was a complete failure. It was put down in an open plain north of the village of Ganara. It passed through 34 feet of earth and 18 feet of quicksand, in which no further progress could be made, as the sand filled the tube faster than it could be removed by the "pump" or mineral lifter. A second borehole 200 yards farther south (No. 5) was equally unsuccessful. After passing through 22 feet of soil and 24 feet of quicksand it also had to be abandoned. There was not time for more attempts in this direction.

The boring to the west (No. 3) was on higher ground, just south of the village of Tatpali. It gave—

		Ft.	In.
(No. 3.)	Soil and gravel	3	7
1 ?	Sandstone, yellow, brown, and red	29	9
2 ?	Pale coloured shale...	10	0
	Red and yellow sandstone with some shale	7	0
	Shale, pale and dark	13	0
3 ?	White sandstone with a little shale and brown sandstone...	24	8
		88	0

In my absence this borehole was stopped by Mr. Heppel, and another (No. 6) started 250 yards to the south-east. This was on somewhat lower ground, and as the beds dip south at a low angle the section is probably that of the same beds :—

		Ft.	In.
(No. 6).	Soil	11	0
1 ?	Brown sandstone	13	10
2 ?	Buff shale	6	0
	Red sandstone	2	0
	Dark shale	6	0
3 ?	White sandstone with darker bands	46	0
		84	10

These sections I am strongly inclined to believe are in the same beds as Nos. 1 and 2. We have the same general succession, brown and yellow sandstone above, then a thick bed of shale, and then white sandstone. I have recommended that one of the boreholes should be carried out to a greater depth on the possibility of these beds belonging to a higher horizon ; but I cannot think this at all probable. The evidence afforded by these boreholes appears to indicate that the coal thins out and disappears to the westward within a short distance.

Meantime a locality for a small pit had been selected up the Ganar stream, 350 yards north-east of No. 1 borehole, at a spot where some yellow sandstone, just like that immediately over the coal, crops out in the bank of the nala, in the expectation that this would be close to the outcrop of the coal, and that a sinking of a few feet would produce abundance of coal to enable the quality

to be fairly tested. A jumper hole, subsequently deepened by boring (No. 7) was put down in order to ascertain the presence of the coal. This gave—

			Ft.	In.
(No. 7).	1.—Yellow sandstone		29	6
	2. Buff shale		24	0
	2. Dark shale		6	0
	2. *Coal*		1	3
	2. Dark shale		26	3
			87	0

showing that the beds are nearly flat, and that a great increase of thickness in the shale has been accompanied by a diminution in the coal. A pit was therefore commenced close to No. 2, but when it was only 13 feet deep, the quantity of water met with retarded progress so much that it was considered advisable to commence another on the high ground 30 yards west of No. 1, as, although it would be a little deeper, it would not be equally liable to flooding, and might be used for the extraction of coal. A borehole has shown that the section is the same as at No. 1. This pit is now in progress.

Meantime one more boring (No. 8) was made only 200 yards west by north from No. 1. The section was—

			Ft.	In.
(No. 8.)	Soil and gravel		10	5
	1.—Coarse brown sandstone		4	0
	2. Light coloured and buff shale		9	0
	2. Red sandstone		3	0
	2. Light blue shale		2	9
	2. Red sandy clay		14	3
	2. Variegated clay		13	0
	2. Dark shale		21	7
		Total...	78	0

This boring was in progress when I had to leave at the end of May, and I have not yet received accounts of its completion. The enormous thickness of shale recalls the section in No. 7, and both sections may possibly be below the white sandstone which underlies the coal. But it is more probable that the shale represents the shale and coal found in the two first boreholes.

Lastly, as the absence of coal had been proved to the north-east and west, and no borings had been found practicable to the east, while the ground to the south appeared equally unfavourable for boring, except at a place on the bed in the Godavery where operations might at any moment, at the season now reached (June), have been stopped by a rise in the river, a borehole was recommended 200 yards south of No. 8 and south-west of No. 1. This (No. 9) has given the following section, sent to me by Mr. VanStavern since my arrival in Calcutta—

			Ft.	In.
(No. 9.)	Soil, etc.		39	0
	1.—Brown sandstone and conglomerate		23	0
	2. Dark shale		3	0
	2. Ironstone		2	6
	2. Shale		2	0
	2. *Coal*		1	6
	2. Shale		2	0
	2. *Coal*		2	1
	2. Shale, carbonaceous...		2	0
	2. *Coal*		1	6
	2. Shale, carbonaceous...		1	6
	2. *Coal*		1	0
	2. Shale, carbonaceous...		1	0
	2. *Coal*		2	0
	2. Shale, carbonaceous...		1	0
	2. *Coal*		1	0
	2. Shale, carbonaceous...		2	0
	2. *Coal*		23	0
	2. Shale			
			112	7

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The section is remarkably like that at No. 2. It decidedly strengthens the evidence in favour of all the boreholes having passed through the continuation of the same beds, for we have in this case a great thickness of shale as in Nos. 7 and 8, with the coal as in No. 2. The total thickness of coal as yet proved in this last borehole is 10 feet 7 inches.

To sum up the evidence: the presence of coal has been proved over a small area which contains probably about 25,000 tons, of which quantity it is as well not to assume that more than one-half can be profitably extracted, owing to the great admixture of shale. It is probable that the seam may be traced for some distance to the south, because the amount of coal, so far as is known, increases in that direction, but it is hardly likely that a seam which thins out and disappears within so short a distance as 200 yards can be depended upon for any long distance. The quality has not yet been accurately ascertained. If on cutting into the coal it is found to burn fairly, a considerable quantity may be extracted, far more than sufficient to well repay the expenditure incurred in boring; but, except in the improbable case of the coal continuing for a distance to the south and east, no permanent supply can be depended upon from this locality. The great admixture of shale and the variation in the seam will render it necessary to mine a large quantity of useless rock, and this will increase the cost of the coal, but in a country where no other supply exists, this alone should not prevent the coal being worked.

The locality is most favourable. The river is within half a mile when full, and about a mile during the dry season, and so soon as the coast canals are completed, it will be in constant water communication with Madras.

In conclusion, I would recommend that the remainder of this small tract of coal-bearing beds be thoroughly explored, as, even if no extensive seam of coal be found, a considerable quantity of useful fuel might be discovered, which would be available on an emergency. North of the river a borehole should be put down below the high bank at Rajgumpa, at a spot where conglomerate is seen in the river-bed, in order to test if the coal continues so far to the south-east. A boring might also be made where sandstone occurs in the stream north-east of Gaoriopeta, and another south of the large tank near Egerpeta, west of Tatpali, and one of the boreholes already sunk, for preference No. 1, should be continued until the metamorphics or Talchirs are reached. There is little chance of good from any further exploration on the north bank. On the south or right side of the river, the series of borings planned west of Madavaram should be carried out. The small breaks in the section near Amravaram might be explored in the same manner, and especially a spot above the mouth of the large stream which enters the Godavery just above the village, as small fragments of shale and coal are hereabouts scattered along the edge of the river, and may indicate a coal seam below the sandstone exposed at a place where there are some bushes beneath the bank.

If all endeavours to find a permanent coal-supply in this locality fail, an eventuality for which we must be prepared, the next chance is near Lingala. Here I consider further exploration in British territory as almost hopeless, the Talchirs must crop out everywhere below the mouth of the Tal close to the river-bank, so that the Damudas are confined, or nearly so, to the bed of the river and the country on the opposite side. Above the mouth of the Tal for some distance it is simply impossible to say what exists, for the whole country is covered with thick alluvium as far as Cherla, where the only rocks that are known to occur appear to me undoubtedly Kamthis, and all the Damudas and Talchirs are overlapped. The only plan by which any good can be done is an exploration of all the breaks in the section exposed above the top of the Talchirs at Sangaram on the right bank of the river in the same manner as I have recommended near Madavaram. The dip varies from 10° to about 20°, and the depth to which the boring in each case must be sunk will be found by multiplying the length of the break by the tangent of the angle of dip.

I am under great obligation to Mr. VanStavern for the very thorough manner in which he has aided me and for his readiness to carry out every suggestion I made. Mr. Heppel's services in charge of the boreholes were invaluable; it is mainly due to his thorough knowledge of boring and to his hard work, in an intensely hot season and despite many difficulties, that so much has been accomplished in a short time.

From E. B. CARROLL, Esq., to F. MATHEW, Esq., dated 25th July 1870, No. 1-3,766.

I ENCLOSE copy of the result of the Nerbudda coal trials.

This was just ready for last Mail, and I sent Mr. Baynes a copy, but was unable to send you one.

The result is satisfactory on these figures. This coal at Rupees 9 is as good as English at Rupees 10 to 12½. I should think, allowing for every thing, that is well worth English at the latter figure.

MEMORANDUM.

No. 4,435.

COPY, with copy of accompaniment, forwarded to the Consulting Engineer for Railways for information.

(Signed) T. R. LIGHT,
Secy. to the Agent, B. B. and C. I. Railway Company.

Remarks by W. WILKS, Esq., *on trial of Mowpani coal—Trip from Bombay to Kurjut.*

STOPPED at Bhandoop to take water and prick up the fire. Steamed well from Bombay to Callian; 1 hour occupied at Callian cleaning fire. Bars entirely covered with clinker, varying from 6 to 10 inches in thickness; 30 minutes occupied at Narel cleaning fire. A good quantity of clinker taken out, kept from 80 to 100 lbs. of steam from Callian to Kurjut. Steamed much better on this occasion than on the previous one; appears to steam much better with a heavy fire than with a light one. No time lost on the road. Number of bars, 15.

Remarks by W. WILKS, Esq., *on trip from Kurjut to Bombay.*

STEAMED very fair from Kurjut to Callian; 30 minutes occupied at Callian cleaning fire. Bars covered with clinkers, from 4 to 10 inches in thickness. Stopped at Bhandoop to take water and prick up the fire. Kept from 80 to 100 lbs. of steam from Callian to Bombay. No time lost. Number of bars, 13.

From C. W. HAWKINS, Esq., Locomotive Superintendent, to the Agent, Great Indian Peninsula Railway Company No. 1301.

HEREWITH I forward you the Inspector's remarks on a trial of the Nerbudda Company's coal.

Remarks by W. WILKS, Esq., *on trial with the Nerbudda Iron Company's coal without coke.—Trip from Bombay to Kurjut.*

STEAMED well the whole journey; stopped at Bhandoop to prick up the fire and take water; time occupied at Callian cleaning fire 15 minutes; clinkers taken out about 3 inches in thickness; did not clean the fire from Callian to Kurjut.

Remarks by W. WILKS, Esq., *on trip from Kurjut to Bombay.*

STEAMED well the whole journey; pricked the fire up at Callian and Bhandoop; did not extract any clinker.

No. 37.

COPY of the above and of the report forwarded to the Public Works Department for information.

(By Order.)

(Signed) J. GEOGHEGAN,
Under-Secretary to the Government of India.

No. 298. ORDER THEREON, 15th November 1871, No. 2,903.

RAILWAY, No. 39.

COMMUNICATED to the Consulting Engineer for Railways in continuation of G. O. No. 1,971, dated 27th July 1871.

2. The attention of the Superintending Engineers of the 1st and 2nd Divisions will be drawn in connection with G. O. No. 2,396, dated 20th September 1871, to the concluding portion of the letter from the Government of India regarding the preparation of a project for the completion of the East Coast Canal.

(True Extract.)

(Signed) J. CARPENDALE, Colonel, R.E.,
Secretary to Government.

To the Consulting Engineer for Railways.
,, Superintending Engineer, 1st and 2nd Divisions.

Rec'd dispatch.

Exd. F. R. Bantleman.

All communications should be addressed to the Secretary.

No. 1570R.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

RAILWAY.

To

The Secretary to the Government
of Madras
Public Works Department (Railway)

Simla, 29th August 1871.

Sir,

I am directed to acknowledge the receipt of your docket No. 1972 dated 27th July 1871 forwarding copy of Madras Government proceedings, Railway No. 52 of 1871, which show that His Excellency the Governor in Council believes that no opinion regarding the future use of the Wurdah Valley Coal in Madras can be come to without further information as to the value of the fuel. The probability of the charges for freight between Coconada and Madras being materially reduced, in event of the Wurdah Valley coal being found to be of better quality as compared

with English coal than has been hitherto supposed, is also discussed in these proceedings.—

2. In reply I am directed to forward for the information of the Madras Government, the papers mentioned in the margin which will give all the information which is now in the possession of the Government of India as to the heating qualities of the Nerbudda Valley and Wurdah Valley coals, together with the results of the exploration for coal in the Godavery Valley near Dumagudium.—

From Chief Comm^r Central Provinces No. 188/2193 dated 14th May 1870 and enclosures.—
To Ditto No. 1087 R. dated 18th June 1870
From Bombay No. 948 dated 5th July 1870 and Enclosures.—
From Ditto No. 1089 dated 2d Aug^t 70 & enclosures
To Ditto No. 1434 R. dated 16 Aug^t 1870
From Ditto No. 1242 dated 6th September 70 and Enclosures.—
From Bengal No. 922 G. d/ 8th May 71 & enclosures
To Ditto No. 886 R. dated 22nd May 1871
From Department of Agriculture Revenue and Commerce to P. W. D. No. 37 dated 11th August 1871, forwarding copy of Mr. Blanford's report on coal boring operations on the Godavery, and of the orders issued thereon.—

3. Continued trials with Nerbudda Valley and Wurdah Valley coals tend to give confidence in the value of both as fuel for locomotive purposes. The experiments have shown that by a judicious arrangement of the fire bars this inferior coal can be more completely consumed within the firebox than was at first supposed possible, and there is every probability that the East Indian Railway and the Great Indian Peninsula Railway will receive from these sources of supply as much coal as they will together require on one thousand miles of Railway, as soon as the collieries are fairly opened.—

4. There is, however, no present reason to believe that ten tons of either Wurdah Valley or Nerbudda Valley coal are worth more for heating purposes than six or seven tons of ordinary English coal, such as is usually laid down in Indian ports, and the Government of India concur in the opinion that so long as English coal can be delivered in Madras at Rs. 20 or Rs. 25 per ton it is unlikely that the Wurdah valley coal can be economically used on the Madras Railways.—

5. Mr. Blanford's and Mr. Vanstavern's researches on the lower Godavery show clearly that one small bed containing 25,000 tons of coal and shale may be profitably worked, and its close proximity

to

to the river renders this small isolated bed the more valuable. Mr. Blanford is not sanguine as to the discovery of a permanent coal supply in British territory in this neighbourhood, but the investigation hitherto has been extremely partial and many districts remain unexplored. The Governor General in Council has directed that the more complete exploration suggested by Mr. Blanford shall be made, and His Excellency in Council is not without hope that the further search may be successful, and that if the East coast canal were completed Madras may be supplied with indigenous coal of good quality at moderate cost. Meanwhile I am to suggest, for the consideration of the Government of Madras, the expediency of taking steps towards the preparation of a project for the completion of inland water communication between the delta of the Godavery and Madras.—

I have the honor to be,
Sir
Your most Obdt Servt,

C. P. Wilmot Major R.E.
Deputy Secretary

Gl.

Public 1871 Department
Original Letter from Govt
From No: 4277.
The Govt of India

Date 29: Augt
Rd 9: Sept } 1871.

Enc 10.

Forwarding into observations, papers regarding Nerbudda valley and Wardah valley Coals together with the results of explorations for Coal in the Godavery District and suggesting the preparation of a project for completing the inland water communication between Madras and the Godavery with a view to indigenous Coal being supplied to Madras.

No 297

No: 2903. 15: Nov/71.

No: 2903.

Communicated to the Consulting Engineer for Railways in continuation of G. O. No: 1971 dated 27th July 1871.

The attention of the Supy. Engineers of the 1st & 2d Divisions will be drawn, in connection with G. O. No: 2396 dated 20th Sept/71, to the concluding portion of the letter from the Govt: of India regarding the preparation of a project for the completion of the East Coast Canal.

13 Oct.

To Consulting Engr for Railways.
" Supy Engrs. 1st & 2d Divs
" Revenue Dept.

Dcap 2-17/4/71.

Rule 150
39

C.P. 4277

Govt. of {1873} Madras.

PUBLIC WORKS.

To

Dated

Recd. Encl.

G. O., 15th June 1878, No. 2903

Nos. 297 & 298

Canals in the Godavery District

Letter from the Govt. of India forwarding papers regarding the Nerbuddah Valley and Wurdah Valley Canals together with the results of explorations for communication to the Converting Engr. for Railways and the attention of the Supdg Engr. of the 1st & 2d Divisions called regarding the preparation of a project for the completion of the East Coast Canal